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Use of federal lands for commercial and recreational activities contributes significantly to the economic stability of many rural areas. Recent increases in demand for recreational use have created conflicts between uses and among users. Some are questioning the use of public land for private gain. The seemingly low grazing fees paid by western ranchers have been an additional catalytic agent. One significant question that arises is, how important are the present uses of federal lands to the total economy of an area? More specifically, what is the contribution to the economy of a given area from the use of federal lands as a source of livestock forage? To help answer this question, the economy of Grant County, Oregon was studied in detail.

To determine the extent of federal grazing in eastern Oregon, data was obtained from a sample of livestock permittees with the

Forest Service and the Bureau of Land Management. Information concerning number of cattle grazed, Animal Unit Months of grazing, number of brood cows owned, number of privately-owned acres, and production of forage from private land was obtained.

All business activity in Grant County was classified into one of fourteen sectors. Systematic random sampling and personal interviews were utilized to obtain information from the commercial businesses, and mailed questionnaires were sent to the agricultural producers. The data obtained was used to construct a transactions matrix. A matrix of input-output, or technical, coefficients was then derived.

Ranches dependent upon federal grazing had a total output (gross sales) in 1964 of nearly $4 million, of which $3 million came from outside the County through exports. The ranches in this sector spent $0.48 per $1.00 of gross sales for the purchase of inputs from Grant County's businesses (exclusive of purchases of labor from the County's households.) Ranchers with federal grazing spent $1,792,530 in Grant County in 1964 for business inputs only, not including labor hired nor personal expenditures. Since these ranchers use both federal and private lands, it is difficult to precisely allocate how much of this quantity is attributable to each source.

The lumber industry spent only $0.24 per $1.00 of output on the purchase of inputs in Grant County (not including $0.30 wages per

$1.00 of output) but because its gross output was large, this brought $3,304,347 to the County's businesses.

A recent study sponsored by the Bureau of Land Management and the Forest Service showed that a 20 percent reduction in federal grazing use would cause an 11 percent reduction in gross ranch income. Using this information, a similar reduction in grazing use in Grant County would cause the total output of the Dependent Ranches sector to decline by $399,578. When this lower output level was run through the model, the output of the remaining 13 sectors was shown to decline by $244,161. An additional, indirect loss to the Dependent Ranches sector brought the total business reduction of all 14 sectors to $623,739.

An income multiplier was computed to show the impact on County household incomes from this 20 percent reduction. The Dependent Ranches sector had an income multiplier of 1.801680. If the Dependent Ranches sector had its output reduced by the 11 percent, it would cause a loss of household incomes in that sector of $39,563. When this was multiplied by the income multiplier, the total income loss to all households in Grant County from the 20 percent reduction of federal grazing was $71,280.

It was not possible to investigate the extent to which these losses might be offset. If several key recreation areas were closed to livestock and the increased recreational use was significant,

increased expenditures by recreationists could reduce the net loss. However, because of different sectoral distribution of the direct effects, the indirect effects, and thus the total effect, would most likely be different.

AN INTERINDUSTRY ANALYSIS OF THE IMPORTANCE OF GRAZING ON FEDERAL LANDS TO THE ECONOMY OF GRANT COUNTY, OREGON

by

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AN INTERINDUSTRY ANALYSIS OF THE IMPORTANCE OF GRAZING ON FEDERAL LANDS TO THE ECONOMY OF GRANT COUNTY, OREGON

I. INTRODUCTION

Use of the federal lands is going through a period of transition. Early in the history of this country land was abundant, sparsely occupied by people, and under certain conditions, practically free. Through various offerings and schemes, the Government encouraged inhabitation of the west to help strengthen the economic base of the entire nation. The remaining land that was not settled was looked upon by the pioneers as theirs for the taking; if they did not use it someone else would. This atmosphere encouraged subjugation and when the soil was depleted, or the trees completely harvested, or the grass consumed, it was easy to move to another area with more promising attributes. It was realized during the Conservation Era of the early 1900's that this type of action could not prevail indefinitely without doing irreparable damage to the natural resource complex of the country. The Forest Service and the Grazing Service were organized to control use of the western part of the nation on the assumption that since the public lands belonged to all of the citizens of the United States, it was the Government's responsibility to protect them from the ravages of those with a somewhat shorter planning horizon than was felt beneficial to the nation as a whole.

The federal lands are not an insignificant portion of the total land area of many of the States; especially those in the West. As of June 30, 1963 the Federal Government owned lands which comprised 34 percent of the total land area of the 50 States. The twelve Western States, excluding Hawaii, contained 94 percent of the Federal holdings. The proportion in each of the twelve States varies from nearly 100 percent in Alaska, down to 29 percent in Washington. Table I shows what proportion of each of the twelve western States is under federal control and/or ownership.

TABLE I. FEDERAL LAND AS A PERCENTAGE OF TOTAL LAND IN EACH WESTERN STATE, 1963.

State	Percent	State	Percent
Alaska	100[1]	Arizona	45
Nevada	86	California	45
Utah	66	Colorado	36
Idaho	64	New Mexico	34
Oregon	52	Montana	30
Wyoming	48	Washington	29

[1]Because much of Alaska is unsurveyed, agencies can report only estimated acreage and thus the sum of individual agency estimates exceeds the accepted total area of the State.

Source: Government Land Acquisition (2).

The General Services Administration has classified approximately two-thirds of the federal lands as forest and wildlife land, 20 percent is considered grazing land, and three percent is parks and historic sites. The remainder consists of flood control and

navigation areas, military installations, airfields, office sites, and harbors (2).

Ninety-five percent of the federal lands are controlled by two agencies: the Department of the Interior with 71 percent of the total, and the Department of Agriculture with 24 percent. Of the land controlled by the Department of the Interior, the Bureau of Land Management (BLM) administers 487, 674, 063 acres or 88 percent of it. Of this BLM acreage, 99. 9 percent lies in the 12 western states listed in the preceeding table. The vast majority of this acreage (excluding O & C timber lands in Western Oregon)[1] is included in Grazing Districts while the remainder is widely scattered and administered under a separate section of the Taylor Grazing Act. The Act, and the administration thereof will be discussed later in the thesis. The Forest Service administers 99. 8 percent of that land controlled by the Department of Agriculture and 86 percent of the Agency's lands are located in the twelve western states mentioned above (35).

Because of their extreme heterogeneity, the public lands defy

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[1] O & C lands, in Western Oregon, were initially granted to the Oregon and California Railroad Company to aid in the construction of railroads. They were later forfeited and returned to the control of the federal government by revestment of title. This term O and C has also come to apply to the reconveyed Coos Bay Military Wagon Road lands which were originally granted to the State of Oregon to aid in construction of the Road, but were later forfeited and reconveyed to federal control (35).

generalized statements concerning their physical attributes. Precipitation ranges from a few inches per year in Death Valley to over 100 inches in the Cascade Mountains. Over 30 percent of the area in the western states receives between 15 and 20 inches of precipitation annually, and 20 percent of the area receives less than 10 inches (26). The vegetation ranges from alpine meadows to the Sonoran desert shrub; from the short grass sod of Eastern Montana to the annual wild oats of the Pacific Slope; from the sagebrush range of the Great Basin to the wooded grassland and meadows of the mountains surrounding the Basin.

The Problem

The current problem concerning the use of federal lands is not the traditional conflict between sheepmen and cattlemen; but rather the problems which have arisen as more people become cognizant of, and distressed over the commercial use of federal lands. Many of the current uses of federal lands such as livestock grazing, lumbering, and mineral exploration have gone on for a long period of time. It was not until recently that these uses began to be questioned by some people.

Because these uses have a long history, it is not an easy matter to change use patterns without rendering economic loss. Federal lands are used by many ranches in the west as integral parts of a

year long livestock operation. Most forages in the west are seasonal and can be utilized during certain times of the year only. To deny use of the federal range portion of the ranching operation can often mean that the privately held portions are rendered useless. Because ranches are tied to the federal lands, livestock ranches usually have artificially high market values reflecting the federal portion of the operation. A loss of part of the yearly grazing would make many ranches practically worthless.

There are two compelling reasons why the severance of grazing upon federal lands should not be taken lightly. One is physical, the other economic.

Physical Relationships

The physical aspect will be discussed only briefly since the interest here is economic. It is accepted by ecologists that the vegetative resource is maintained in better balance when grazing use is not overly concentrated on specific forage species. This fact is important in the face of increased demands by hunters and hunting groups for greater numbers of big game animals. Because of dietary, and foraging differences between cattle, and the common big game animals (antelope, deer, and elk), the combined use by all of these animals, in proper relation to the available forage, results not only in greater production of meat per acre, but also greater total

production of vegetation. Besides the higher vegetative production, the species composition (proportion of various plant species in the area) is maintained in better balance.

Economic Relationships

When the federal agencies were established to help control grazing use, those ranchers who were well established in the area, and whose normal ranching operation consisted of usage of the federal range, were given grazing privileges on the public lands. As a result, many of the rural economies throughout the West are dependent upon the many ranches with federal grazing privileges. Because the product from these ranches is primarily exported out of the local area, much of the gross income received by the ranchers is what is termed "basic income." Basic income refers to new money which is brought into the local economy, a large share of which is spent in the local area for supplies. This new money is quite a significant stimulant to the economic well-being of an area.

Basic income also comes from other sources. Tourists and recreationists who stop in the area bring new money into the local economy. Lumbering activity also creates basic income as most of the products from this industry are exported out of the area.

Because of this interdependence between uses of the federal lands and the economic well-being of many rural economies, there

is need for more knowledge of the importance of these uses to the economic health of areas where federal lands predominate. Until this relationship is known, and the ultimate impact of changes in resource allocation is defined in terms of income and income distribution, decisions will continue to be made that could very well lead away from, rather than towards, the most beneficial use of the public lands.

To this end a study was initiated in 1965 to investigate the economic importance of utilizing public lands in conjunction with private lands for the grazing of livestock, and to determine the economic interdependence which exists among commercial and agricultural firms in a rural economy.

Objectives

The objectives of the study were: 1) to depict the extent of grazing on public lands in Oregon and its relationship to privately owned resources of those with grazing privileges; 2) to ascertain the extent of economic activity attributable to the use of public lands as a source of feed for cattle operations in an eastern Oregon county; and 3) based upon the findings of objective (2), to project the impact of adjustments in federal grazing on the total sales of the businesses in this rural economy, and the resultant change in household income of the area's residents.

Study Organization

To fulfill the first objective, a broad overview of grazing activities in eastern Oregon is presented. The majority of the material is from the files of the U. S. Forest Service and the Bureau of Land Management and was obtained by personal visitation and interview. A sample of the ranches in each administrative unit[2] was drawn to detail the size distribution, extent of use of the federal lands by the various size ranches, and the nature and extent of deeded lands utilized in the ranching operation in conjunction with the federal range. This material is presented in Chapter II.

Objective number (2) was accomplished by selecting an eastern Oregon county with a substantial acreage of federal land and whose economic well being depended upon several uses of these lands. Grant County, in central eastern Oregon, was selected as the area in which to concentrate the analytical portions of the research. Data on business activity and interdependence of the County's businesses were obtained for the 1964 calendar year. This was done through personal interviews with about 30 percent of the County's commercial businesses, and through mailed questionnaires to the agricultural producers in the County. Input-output analysis was utilized to quantify the interdependence of economic activity and to project the

[2]Throughout the remainder of this thesis a Grazing District or a National Forest will be referred to as an "administrative unit."

postulated impact on business income from a change in the quantity of federal grazing in the County.

Chapter III presents the theoretical framework of input-output analysis. Chapter IV presents the conceptualization and design of the Grant County Model specifically. Chapter V presents the empirical data for the Grant County economy as it was in 1964. Chapter VI presents the projected economic impact resulting from a reduction in federal grazing. Using secondary data on ranch impact, the model is utilized to project this change in agricultural income to the remaining businesses in the County. Some of the ramifications of this hypothetical reduction in grazing are explored.

The summary, conclusions, implications to be drawn from the research findings, and the possibilities for further research are discussed in Chapter VII.

II. FEDERAL GRAZING IN EASTERN OREGON

To place livestock grazing on federal land in proper perspective and to set the stage for the analytical portions of the thesis, it is felt a brief exposure to the nature of grazing use of the federal lands is necessary. First, a discussion of the land administering agencies which lease the grazing to ranchers will be presented. Following this, a brief exposition of data gathered from these agencies will serve to acquaint the reader with grazing on federal lands.

Land Managing Agencies and Policies

The administering agencies of grazing lands in eastern Oregon are the Bureau of Land Management, the U. S. Forest Service, the State of Oregon through its State Land Board and the U. S. Fish and Wildlife Service.

Bureau of Land Management

The Grazing Division, later Grazing Service, was founded in 1934 to administer the new Taylor Grazing Act and in 1946 was consolidated with the General Land Office to form the Bureau of Land Management. The Bureau administers, exclusive of the O & C Railroad lands in the western part of the State, 13,299,411 acres of public domain in Oregon of which 98.6 percent is in the nineteen county area east of the Cascade Mountains (Appendix Table I). It will be

noticed that the percentage of B. L. M. land in the counties varies from a low of 0. 1 percent in Hood River County to a high of 73. 0 percent in Malheur County.

When the Taylor Grazing Act was first enacted, grazing districts were formed where there were sufficiently large acreages of public domain to warrant them. Where scattered tracts of vacant, unappropriated, and unreserved lands were so situated as to not justify their inclusion in a district, the Secretary of the Interior was authorized to lease any such land for grazing purposes under provisions of Section 15 of the Taylor Act. These lands are usually referred to as Section 15 lands and shall be designated as such for the remainder of this thesis. As stated in the Taylor Act, Section 15, ". . . preference shall be given to owners, homesteaders, leasees, or other lawful occupants of contiguous lands to the extent necessary to permit proper use of such contiguous lands . . .(36, p. 9)." The Section 15 lands are leased on a per acre basis to people who generally qualify under the above stated provisions of the Act, the term of such leases normally being ten years in length. The lands incorporated into grazing districts form the bulk of the Bureau's administrative responsibilities. In Oregon, 93. 7 percent of the public land administered by the B. L. M. are included in Grazing Districts.

The main objective of the Act was to alleviate the problem of transient sheep and cattle operations that migrated from state to

state utilizing all of the forage, and then moving on to new areas when the feed ceased to be adequate. This type of ranching operation was encouraged by the common property aspects of the western range. Just as Crutchfield points out for commercial ocean fisheries, because ownership was unclear and free entry obtained, no one had to pay rent. This unpaid "rent" looks like excess profits attracting new operators until costs equal receipts (9). Under this type of ranching operation there was no need to depend upon the same range next year and each successive herd of cattle or band of sheep "mined" the vegetation leaving scant photosynthetic tissue with which to allow vegetal recovery.

To facilitate the objectives of the Act grazing privileges were granted to those livestock operators who were recognized as established and secure, and whose normal range use pattern consisted of a substantial usage of the federal land to be included in grazing districts.

Those operators who owned "land dependent by use," that is, all forage land other than federal range such that the conduct of an economic ranching enterprise required the use of federal land in conjunction with it, must have used such dependent lands for two consecutive years prior to the establishment of a district, or any three years of the five years preceding the inclusion of that area into a grazing district. This land must be "commensurate" in that

it must provide forage of sufficient quantity and quality to support the permitted livestock for the period they were not allowed on the federal range (7). Hence, with these stipulations, it was hoped that those operators who obtained permits would, for the most part, be local citizens concerned about conservation of the range, interested in the economic condition of the area, and most important, answerable for their actions upon the federally owned lands. In the desert southwest, grazing privileges are granted on the basis of ownership of a "water base" instead of land base. Inasmuch as this practice is not applicable to Oregon it will not be discussed here.

U. S. Forest Service

The second major landlord in eastern Oregon is the U. S. Forest Service. This agency was created in 1905 at which time the existing forest reserves were transferred from the Department of the Interior to the Department of Agriculture. The Forest Service administers a total of 186,302,639 acres in the United States of which 15,001,833 acres are in Oregon. The nineteen county area in eastern Oregon contains approximately 69 percent of the total Forest Service land in the State, (Appendix Table I).

In order to obtain a permit to graze the national forests, an individual must own ranch property and livestock and he also must require the grazing in order to complement or round out his yearly

livestock program. When administration of the national forests was in embryonic stages, a preference was shown to those ranchers who had been using the land that was to be included in forests. After those forage requirements were met any excess forage was allocated to nearby homesteaders or farmers. Since 1925 licenses have been issued on a ten year basis, before that time an annual license was the prevailing type.

Another type of Forest Service land is the Crooked River National Grassland between Madras and Redmond in central Oregon. The administration of this area is separate from the routine Forest administration. There are 105,925 acres in the Grasslands of which 101,000 is grazed. In 1964 2,967 cattle belonging to 50 different operators grazed the Grasslands for 12,636 AUM's of use.[3]

Forest Service lands, usually much more so than B. L. M., are in demand for uses such as recreation and watershed protection. Thus the grazing program is more competitive with other uses than is the case with the more desert areas under BLM administration. Many of the forested regions comprise the most critical watershed areas in the West as well as contain the majority of the West's scenic splendors. Recreation usage is highly concentrated on Forest Service lands and the trend will most certainly continue in this direction. This does not mean that BLM land has no recreation usage,

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[3]Personal interview with Mr. Joe Mohan, Supervisor.

nor does it mean that the BLM is not encouraging recreational use of its lands. It merely points out the fact that the characteristics of the forested regions make them more preferred than the low elevation desert areas. Not surprisingly, the Forest Service holdings contain the vast majority of marketable timber in the U. S. and this activity alone accounts for most of that agency's income.

Both agencies, BLM and Forest Service, utilize advisory boards composed of local stockmen, but in different manners. The BLM is instructed by statute to have district Advisory Boards, the members being elected by the range users in each District. The District Boards vary in membership from 5-12 with an individual being selected to represent the wildlife interests in the area. These boards meet with the District personnel to discuss licensing applications, changes of numbers of season of use, adjudication of grazing privileges, planning of range improvements, and to assist in the settling of disputes among and between users. Since the Boards are advisory in nature they can be, and sometimes are, overruled by the District personnel. The Boards usually consist of the most progressive ranchers in an area and thus are quite beneficial to the BLM program. District board members are eligible for state board membership and the state board members are in turn eligible for the national advisory board. Hence there is communication from the District level up to the Washington D. C. office of the BLM.

The Forest Service also uses local advisory boards although not directed to do so by law. Their members are either elected by local stockmen organizations or appointed by the Forest Service. The extent of their influence, as pointed out by Clawson (6), ranges from being almost negligible, to being comparable with BLM Boards.

State of Oregon

The Oregon State Land Board is responsible for the administration of approximately 771, 304 acres in the State which consists of land acquired through grants by Congress, rights given by the State legislature, and that obtained by escheat or various other statutory operations. The nineteen county area in eastern Oregon contains about 86 percent of the State owned land or approximately 665, 481 acres. Eighty six percent of this amount is found in the three county area of Lake, Malheur, and Harney, (Appendix I, Table I) (23).

The State Land Board was created to administer for the people of Oregon, those sections of land (usually the 16th and 36 sections in each township) which were given to the State by the Congress for school purposes. In addition to these scattered parcels, there are larger pieces of land acquired as previously mentioned that form sufficiently large blocks so that their administration is facilitated by leasing them as one unit. The majority of these blocked grazing lands occur in Malheur and Harney counties.

The State normally issues annual leases to livestockmen and charges a fee that approaches 8 1/2 cents per acre for the grazing season. The leases usually remain in the same hands over extended periods although this is neither encouraged nor discouraged by the Board.

Since the Board is not an administering agency in the same sense of the word as are the BLM and Forest Service, it is impossible to indicate the precise numbers of cattle using State lands, the season of use, nor the fee per AUM. The carrying capacity of State lands is taken from that of range surveys of adjacent and similar government land and the season of use is closely correlated with the federal land. Thus they are treated like the adjacent federal lands and are usually used in an integrated pattern by the licensee who usually also has a federal permit.

U. S. Fish and Wildlife Service

The U. S. Fish and Wildlife Service administers a total of 444, 024 acres in Oregon which consists primarily of bird refuges and the Hart Mountain Antelope Refuge in southeastern Lake county.

The Malheur National Wildlife Refuge near Burns leases grazing to nearby ranchers at a fee of two dollars per AUM. The total number of cattle grazed on the Refuge in 1964 was 29, 940 for a total of 106, 927 AUM's. Because some outstanding leases are currently

charged a lower rate than the present two dollars, the gross receipts of the grazing program were $190, 770.

Because of the type of vegetation present, most of the Refuge is grazed on a year-long basis; some areas providing fall and winter forage, and other areas near water providing summer grazing. The forage of the Refuge is of fairly high quality for cattle- marshland with sedge, juncas, bur reed, and bulrush; and large areas of giant wild rye and creeping rye (blue-joint). The better-drained lands contain timothy and wild clover mixed with some of the bluegrasses and various forbs.

Applications for grazing privileges are placed with the Refuge and permits are issued when the feed becomes available. There are about 70 permittees at the present, most of whom have held privi-ledges for 25 years or more.[4]

Another waterfowl sanctuary is the Tule Lake National Wildlife Refuge with headquarters at Tule Lake, California. Only one refuge under this system, the Klamath Forest Refuge north of Chiloquin, Oregon, has a grazing program. This Refuge has a total acreage of 15, 226 acres of which about 7, 000 is grazed by domestic livestock. The total number of cattle grazed on the Refuge in 1964 was 416 and they utilized 1, 587 AUM's of forage. The fee per AUM was $1. 50 and the total receipts from grazing fees in 1964 were $2, 381. 10. The

[4]Personal correspondence with Mr. John C. Scharff, Refuge Manager.

grazing season is from May 15 to October 31. Grazing permits are issued first to former land owners, which are the Klamath Indians. Second priority is given to ranchers who grazed the area prior to its inclusion into the Refuge. All permits are annual in nature and must be reapplied for each year.[5]

The Hart Mountain National Antelope Refuge northeast of Lakeview consists of 240,000 acres of which 174,336 are utilized by livestock. During the 1964 grazing season, a total of 3,192 cattle were grazed during the peak season, utilizing 12,509 AUM's. The fee varies from $.50 per AUM on the open range to $1.50 for fenced meadows. Total fees collected during 1964 were $12,529.00. The season of use varies with the vegetation but no cattle are permitted on the Refuge before April 15, and none are permitted after November 30. The forage is primarily sagebrush with lesser amounts of rabbitbrush and bitterbrush. The wheatgrasses and bluegrasses are present as is cheatgrass. Grazing permits are issued on a one, three, or five year basis with the majority being three or five year permits.[6]

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[5]Personal correspondence with Mr. Robert C. Watson, Refuge Manager.

[6]Personal correspondence with Mr. John D. Hill, Assistant Refuge Manager.

Grazing on Federal Land

To help detail the extent of livestock grazing on public lands, information obtained primarily from the files of the Forest Service and the BLM will be utilized. Table II is compiled from the grazing statistical report of the two agencies for the 1964 year.

It is seen that 284,987 cattle (over 6 months of age) and horses were grazed on the public lands in the twelve administrative units during 1964. It needs to be pointed out that a significant portion of ranchers hold both a Forest Service and a BLM permit so these figures of livestock numbers contain some duplication. A total of 1,442 separate permits were issued in the twelve units in 1964. The Forest Service issued 459 of these and the BLM 983. Approximately 40 percent of the ranches selected in the sample held a permit with the other agency.

The twelve administrative units represent the majority of the area in eastern Oregon where range cattle production is of any significance. The figures shown for BLM Districts include only those animals grazed under regular District programs; no Section 15 figures are included.

TABLE II. ADMINISTRATIVE UNITS, NUMBER OF PERMITS ISSUED ON EACH, MAXIMUM NUMBER OF CATTLE AND HORSES GRAZED, AND AUM'S OF USE MADE BY CATTLE AND HORSES, 1964.[1 - 2]

Forest Service				Bureau of Land Management			
Administrative Unit	No. of Permits	No. of Cattle and Horses	AUM's	Administrative Unit	No. of Permits	No. of Cattle and Horses	AUM's
Wallowa - Whitman	119	20,655	113,788	Baker	193	31,597	66,748
Winema	19	2,148	7,411	Burns	187	56,561	246,691
Rogue River	52	2,842	9,126	Vale	302	78,435	399,211
Ochoco	67	6,865	24,391	Prineville	193	17,830	73,641
Malheur	129	19,244	77,368	Lakeview	108	34,468	138,861
Fremont	55	11,972	31,352				
Deschutes	18	2,480	8,294				
TOTALS	459	66,206	271,730		983	218,781	923,152

[1]Source: Annual Grazing Statistical Reports of the Forest Service and the Bureau of Land Management, 1964.

[2]The 459 Forest permits are Preference permits only. These differ from the Temporary permit in that the rancher is more or less "guaranteed" the Preference use each year whereas the Temporary permit is an annual arrangement predicated upon forage availability.

Methodology

Due to the degree of heterogeneity of the cattle industry dependent upon federal lands, it was decided to treat each administrative unit separately. Each administrative unit was visited during the summer of 1965. From the grazing application submitted annually by each rancher, the number of cows owned by each operator was recorded. From this information, a frequency distribution was structured depicting the various ranch sizes in each unit. Because the ranches in some units were much more variable in size than in other units, and because size itself is a relative concept, it was decided not to have a standard breaking point to separate ranch size for all of eastern Oregon. Rather, the frequency distribution of cows owned by the ranches in each unit was discussed with the personnel in the unit, and taken together with the range of size in each unit, a size classification and breakdown was made for each unit. However most units are not very dissimilar in the number of cows owned for each respective size.

Following this stratification on size, systematic random sampling was utilized to draw at least a ten percent sample from each stratum. If a stratum were particularly small, no fewer than five observations were drawn unless there were less than this number in the stratum, in which case complete enumeration was achieved. After selection

of the ranches was complete, further data from the agency records for the ranches included in the samples was obtained - such as number of cows owned, number of permitted animal units at one time on federal range, the season of use, the number of AUM's of use made, and whether or not the rancher drawn in the sample held another permit with a different agency. In addition to this information, the Dependent Property Survey for each selected ranch was used to record the nature and extent of privately owned lands used in conjunction with the federal range. There were eight specific forage categories for private lands, and one that includes all others not listed elsewhere. The nine categories are: alfalfa hay, meadow hay, grains, wet meadow, dry meadow, wet pasture, dry pasture, rangeland, and other land. For each category, the number of acres and the AUM's of forage produced was recorded for each ranch in the sample.

Table III presents a compilation of some of the data which is presented in Appendix, Table II. This material is presented to illustrate the nature of range cattle production in eastern Oregon. The data is classified by administrative unit and by ranch size.

It is noted that nearly half of the ranches (47 percent) with federal grazing are "small." These ranches obtained an average of 231 AUM's of grazing for their livestock from federal lands and produced an average of 911 AUM's of feed on their deeded property which

TABLE III. CHARACTERISTICS OF FOUR SIZES OF EASTERN OREGON CATTLE RANCHES WITH FEDERAL GRAZING PRIVILEGES, 1964.

	SMALL RANCHES										
Units	Number of Cows Owned (1)	Average Number of Brood Cows Owned (2)	Number of Ranches (3)	Size of Sample[1] (4)	Animal Units Permitted (5)	Animal Units Permitted as Percent of No. of Cows Owned (6)	AUM's of Federal Grazing (7)	Acres Owned (8)	AUM's Produced From Owned Lands (9)	AUM's of Federal Grazing per Permitted Animal Unit (10)	AUM's of Privately Produced Feed per Owned Cow (11)
Lakeview	0-199	97	55	5	55	57	172	475	1678	3.1	17.2
Fremont	0-199	120	11	2	66	55	208	1461	854	3.1	7.1
Burns	0-100	74	62	7	59	80	281	562	602	4.8	8.2
Vale	0-199	106	137	13	91	86	583	365	819	6.4	7.7
Malheur	0-199	64	47	5	44	69	181	1228	496	4.1	7.8
Deschutes	0-149	40	6	6	35	88	153	366	424	4.3	10.6
Ochoco	0-149	98	18	5	49	50	170	1669	1247	3.4	12.7
Prineville	0-149	54	115	12	27	50	95	453	959	3.5	17.8
Baker	0-199	95	123	14	54	57	153	361	933	2.8	9.8
Wallowa-Whitman	0-199	116	57	10	72	62	314	1555	1259	4.4	10.8
Winema	0-199	108	12	5	85	79	352	1031	1092	4.1	10.1
Rogue River	0-199	65	40	5	39	60	106	326	574	2.7	8.9
Averages		86	683[2]		56	66	231	821	911	3.9	10.7

[1] If the sample size seems small for several of the units it is because complete records were available only for the number of observations shown in that particular size group.

[2] Sum of column 3.

TABLE III. (cont.)

MEDIUM RANCHES

Units	Number of Cows Owned (1)	Average Number of Brood Cows Owned (2)	Number of Ranches (3)	Size of Sample[1] (4)	Animal Units Permitted (5)	Animal Units Permitted as Percent of No. of Cows Owned (6)	AUM's of Federal Grazing (7)	Acres Owned (8)	AUM's Produced From Owned Lands (9)	AUM's of Federal Grazing per Permitted Animal Unit (10)	AUM's of Privately Produced Feed per Owned Cow (11)
Lakeview	200-449	244	24	5	169	69	642	1133	6969	3.8	28.6
Fremont	200-449	346	19	5	149	43	410	4220	3370	2.8	9.7
Burns	101-350	242	78	9	210	87	1180	2341	1787	5.6	7.4
Vale	200-449	326	84	7	246	75	1731	1242	2285	7.0	7.0
Malheur	200-499	301	47	5	86	29	373	1885	2323	4.3	7.7
Deschutes	150-349	231	9	9	126	54	446	4884	2420	3.5	10.5
Ochoco	150-399	215	29	5	97	45	362	7049	2674	3.7	12.4
Prineville	150-399	205	41	5	130	63	502	395	1654	3.9	8.1
Baker	200-599	267	52	6	250	94	429	1014	2090	1.7	7.8
Wallowa-Whitman	200-599	321	45	5	130	40	629	2482	1477	4.8	4.6
Winema	200-499	256	4	4	52	20	160	1553	3323	3.1	13.0
Rogue River	200-1500	320	12	5	93	29	342	1059	4444	3.6	13.9
Averages		273	444[2]		145	54	600	2438	2901	4.0	10.9

[1] If the sample size seems small for several of the units it is because complete records were available only for the number of observations shown in that particular size group.

[2] Sum of column 3.

TABLE III. (cont.)

LARGE RANCHES

Units	Number of Cows Owned (1)	Average Number of Brood Cows Owned (2)	Number of Ranches (3)	Size of Sample[1] (4)	Animal Units Permitted (5)	Animal Units Permitted as Percent of No. of Cows Owned (6)	AUM's of Federal Grazing (7)	Acres Owned (8)	AUM's Produced From Owned Lands (9)	AUM's of Federal Grazing per Permitted Animal Unit (10)	AUM's of Privately Produced Feed per Owned Cow (11)
Lakeview	450-1149	675	18	5	418	62	1540	1616	4564	3.7	6.8
Fremont	450-1149	759	16	3	268	35	876	2842	4746	3.3	17.7
Burns	351-1000	574	36	7	492	86	2436	3084	3311	5.0	6.7
Vale	450-1149	634	65	6	488	77	3084	1705	3439	6.3	7.0
Malheur	450-1149	728	26	5	361	50	1165	5226	2767	3.2	7.7
Deschutes	350-1200	760	3	3	332	44	886	6484	5921	2.7	17.8
Ochoco	400-2278	646	20	5	187	29	710	8668	3585	3.8	19.2
Prineville	400-2200	865	37	5	231	27	934	4657	5618	4.0	24.3
Baker	600-1700	842	18	5	430	51	1006	3466	4817	2.3	11.2
Wallowa-Whitman	600-2500	1550	17	5	481	31	2400	17582	5427	5.0	11.3
Winema	500-900	667	3	3	210	31	995	5096	3471	4.7	16.5
Averages		791	259[2]		354	48	1457	5493	4333	4.0	13.3

[1] If the sample size seems small for several of the units it is because complete records were available only for the number of observations shown in that particular size group.

[2] Sum of column 3.

TABLE III. (cont.)

EXTRA LARGE RANCHES

Units	Number of Cows Owned (1)	Average Number of Brood Cows Owned (2)	Number of Ranches (3)	Size of Sample[1] (4)	Animal Units Permitted (5)	Animal Units Permitted as Percent of No. of Cows Owned (6)	AUM's of Federal Grazing (7)	Acres Owned (8)	AUM's Produced From Owned Lands (9)	AUM's of Federal Grazing per Permitted Animal Unit (10)	AUM's of Privately Produced Feed per Owned Cow (11)
Lakeview	1150-15200	1623	11	4	669	41	1815	2064	15011	2.7	9.2
Fremont	1150-9000	1500	9	3	317	21	1164	3460	15469	3.7	10.3
Burns	1001-5600	1837	11	5	1255	68	5242	9364	14650	4.7	8.0
Vale	1150-4800	1740	16	5	1199	69	7604	6349	8381	6.3	4.8
Malheur	1150-3000	1725	9	4	383	22	1537	7542	5356	4.0	3.1
Averages		1685	56[2]		765	44	3472	5755	11773	4.2	7.1

[1]If the sample size seems small for several of the units it is because complete records were available only for the number of observations shown in that particular size group.

[2]Sum of column 3.

averaged 821 acres in size. On the average, the small ranches grazed a relatively large number of animal units (in proportion to the number of owned cows) on federal range during the grazing season. The ranchers in this group averaged 66 percent of their owned cows grazing on public lands.

There were 444 Medium sized ranches which averaged 273 breeding cows. These ranches had permits for an average of 145 animal units which represents 54 percent of the number of brood cows owned by the ranches. These 145 animal units utilized an average of 600 AUM's of federal grazing for a four month grazing season (column 10). Medium-sized ranches owned an average of 2,438 acres and produced 2,901 AUM's of forage from these lands. This is approximately 11 AUM's of forage for every breeding cow owned by the ranches. This figure represents months since AUM's divided by animal units yields an index of months. This index relates the ability of the ranch to produce enough feed to sustain the livestock while not permitted on federal range. The index, plus the length of grazing season in months, should approximately equal 12.

Large-sized ranches which total 259 in number and represent only 18 percent of the total number of ranches with federal grazing, are more significant than their number might indicate. These ranches owned an average of 791 breeding cows in 1964, grazed 354 animal units on the federal range (which represents 48 percent of

the brood cows owned) for an average length of 4 months, for 1,457 AUM's. These ranches owned an average of 5,493 acres of deeded property which produced 4,333 AUM's of forage.

The Extra Large ranches comprise only four percent (56 out of 1442) of those with federal grazing but over-shadow the other three size category in extent of operation. The Extra Large ranches owned an average of 1,685 brood cows, more than 500 more than the other three size groups combined. These ranches grazed an average 765 animal units on the federal range or 200 more than the other three groups combined; these animals used 3,472 AUM's of forage (1,200 more than the other three combined); during a grazing season that was a little longer than for the other three sizes (4.2). These ranches owned an average of 5,755 acres of deeded property which produced 11,773 AUM's of forage or over 3,500 AUM's more than the other three size groups combined.

Thus while the Small ranch is the predominant holder of a federal grazing permit with 47 percent of the permits, it is seen from Table IV that almost half of the ranches made less than 1/6 of the use of federal range. Medium-sized ranches with 31 percent of the permits, utilized 27 percent of the available forage; Large ranches with 18 percent of the permits utilized 37 percent of the forage, and the Extra Large ranches, with only 1/24 of the permits, used 1/5 of the federal AUM's in 1964.

TABLE IV. ALLOCATION OF FEDERAL GRAZING PRIVILEGES AMONG FOUR RANCH SIZES, EASTERN OREGON, 1964.

Size of Ranch	Number of Ranches (1)	Percent Each is of Total Number (2)	Average AUM's of Federal Grazing Per Ranch (3)	Total AUM's of Federal Grazing Use By Each Size Group (1x3) (4)	Percent of Total Federal Grazing Use (5)
Small	683	47	231	157,773	16
Medium	444	31	600	266,400	27
Large	259	18	1,457	377,363	37
Extra Large	56	4	3,472	194,432	20
	1,422	100		995,968[1]	100

[1] Actual use made in 1964 was 1,194,882 AUM's. Discrepency here is due to averaging AUM's of use for ranches within size groups for each unit, then averaging all the units for each of the size groups. Then when these figures are multiplied by the number of ranches in each size group, the error results.

It should be pointed out that the acreage and production data for some of the administrative units were often somewhat old. This is not an indictment against the administering agencies but merely points out that ranches are in a constant state of flux and adjustment. Federal agencies have more pressing needs than that of constantly checking the private production of each of the permittees. The permittee is required to notify the agencies if he wishes to transfer his grazing privileges to another piece of property but if he brings more land into production above and beyond his minimum required feed level, these changes go largely unnoticed by the agencies unless they have some reason to check the ranch's production. Both agencies do have provisions for frequent updating of dependent property records but other duties often have a higher priority.

Description of the Study Area

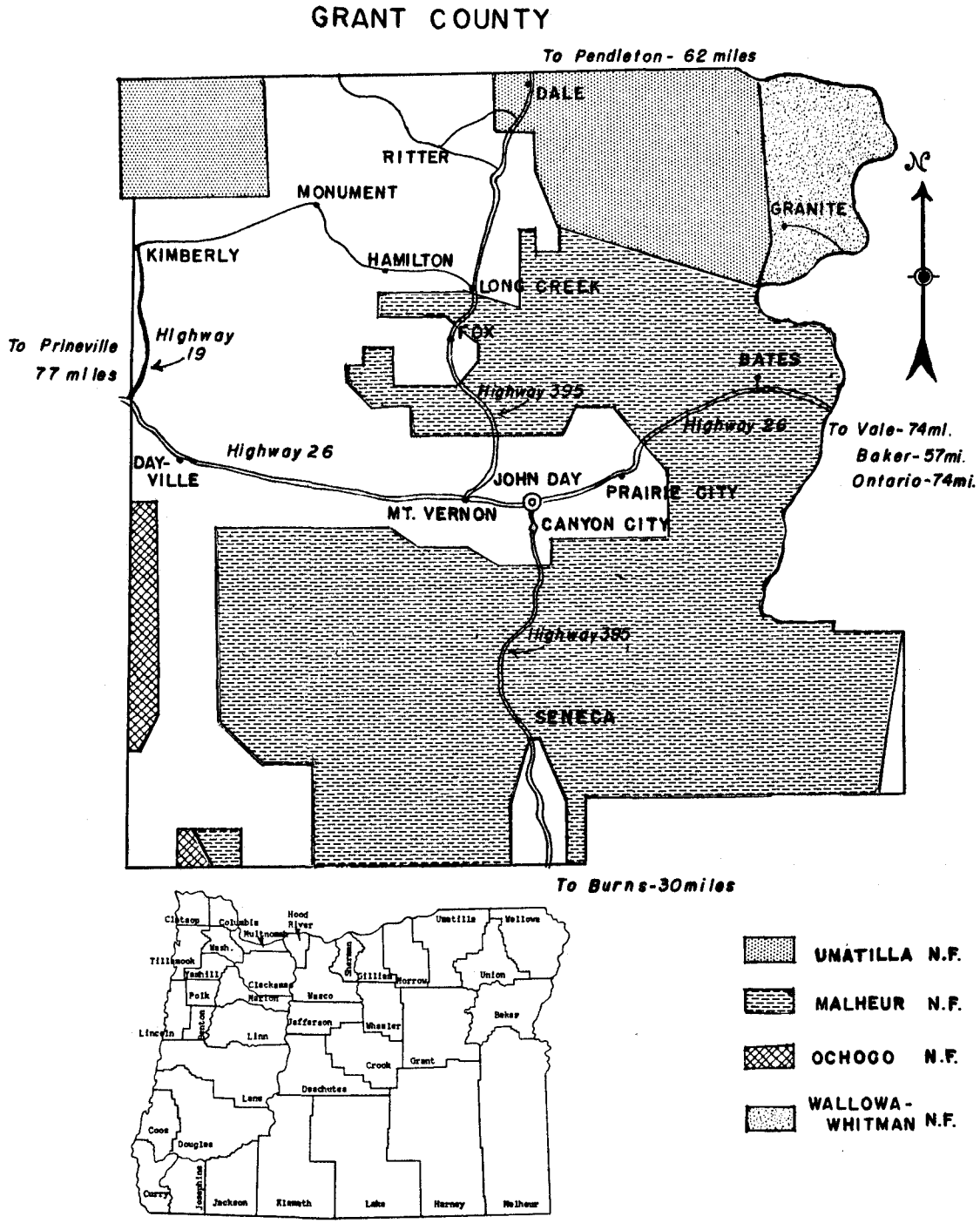
With the preceeding overview of grazing on federal lands in eastern Oregon, the stage is set to more precisely detail the economic importance of federal lands as a source of domestic livestock feed. To accomplish this, an area was needed where federally owned lands comprise a majority of the total land area; where livestock production (specifically cattle) formed a major part of the total agricultural output; where there was adequate recreation potential and watershed protection requirements; where these latter two attributes

would show probable future increases, and yet an area that was not dependent upon livestock production alone. Admittedly, an area that depends upon one economic pursuit is highly specialized and thus susceptible to extreme economic fluctuation. Grant County was selected as a county which met all of these requirements and is the area to which the quantitative and analytical aspects of the research were applied.

Grant County (see Figure 1) is situated at the southern end of the Blue Mountains and encompasses practically the entire principle watershed of the John Day River. Most of the eastern boundary follows the crest of the Blue Mountains which are also the origin of the John Day River. The main fork of the John Day leaves the mountains just east of Prairie City and then follows first Highway 26 west, and later Highway 19 north, to where it leaves the County at Kimberly. This narrow river valley, 75 miles in length, forms the only significant area in the County that supports irrigated agriculture.

The total land area of the County is 4,532 square miles. The population, all rural by U. S. Census standards, is sparse and shows signs of becoming more so. The population density of the County was 1.7 persons per square mile (July 1, 1965) and was fourth out of the 36 Oregon counties for lowest population density. Lake and Harney Counties tied for first place with a low 0.7 persons per square mile followed by Wheeler with 1.1 (32). The 1960 Census listed 7,726

Figure 1.


GRANT COUNTY
To Pendleton - 62 miles
DALE
RITTER
MONUMENT
GRANITE
KIMBERLY
HAMILTON
LONG CREEK
FOX
To Prineville
77 miles
Highway 19
BATES
Highway 395
Highway 26
To Vale-74mi.
Baker-57mi.
Ontario-74mi.
DAY-VILLE
Highway 26
JOHN DAY
PRAIRIE CITY
MT. VERNON
CANYON CITY
Highway 395
SENECA
To Burns-30miles
UMATILLA N.F.
MALHEUR N.F.
OCHOCO N.F.
WALLOWA-WHITMAN N.F.

people in the County while the latest figures for July 1, 1965 list 7,600 (22).

The principle towns in Grant County and their population in 1960 are: John Day - 1,520; Prairie City - 801; Canyon City (County Seat) - 654; Mount Vernon - 502; Long Creek - 295; Dayville - 234; and Monument - 214. Other communities are Bates, Seneca, Fox, Ritter, Kimberly, Granite, Hamilton, and Dale. Those towns with published population figures account for 55 percent of the County's population. The remainder of people live in the smaller communities or on widely scattered ranches (32).

The land ownership in the County is divided among the Forest Service with 1,557,265 acres (54 percent), the Bureau of Land Management with 172,485 acres (6 percent), the State of Oregon with 4950 acres (.002 percent), while the remaining 40 percent is divided among private ownership as well as other small federal holdings.

The Forest Service holdings are divided among four Forests with the Malheur having 863,915 acres, the Umatilla with 303,251 acres, the Wallowa-Whitman with 329,478 acres, and the Ochoco with 60,628 acres. The Bureau of Land Management holdings are not in a Grazing District but are classified as Section 15 lands and consist of small, widely scattered parcels that are leased to adjacent livestock operators by the acre.

The agriculture of Grant County is primarily livestock oriented

with 94 percent of the total value of all crops, livestock, and livestock products being derived from livestock and livestock product sales. Thus out of a total figure for all sales of $4,113,000, $3,865,000 came from the sale of livestock or livestock products and 92 percent of this figure, came from the sale of cattle and calves. The value of crops sold was $248,000 and consisted primarily of hay, wheat, barley, and oats.

As one might expect, the soils and the vegetation of the area go hand in hand with the forested areas characterized by slightly acidic, well drained, brown soils, while the soil of the foothill-grass region is dark brown, nearly neutral, and well-drained. This type of soil and vegetation type makes up about 1/5 of the area of the County and is concentrated along the western edge of the County and up the John Day River valley. The majority of the forested regions of the County are covered by ponderosa pine with lesser amounts of larch along the crest of the Blue Mountains. The range vegetation is primarily low-sagebrush and grass although there are considerable amounts of grass understory in the ponderosa regions.

The climate of the area is one of mild extremes with the average summer temperature being 66 degrees and the average winter temperature being 36 degrees. The average summer precipitation is 1.53 inches and the average winter precipitation is 4.68 inches. Most of the winter precipitation comes in the form of snow (22).

With this brief sketch of the area, a discussion of the analytical tool to be used and how it was applied to the problem at hand follows.

III. THE THEORETICAL FRAMEWORK

An input-output model was selected to analyze the economy of Grant County. Through the use of interindustry analysis, the interdependence of various economic activities could be comprehensively portrayed. By including all cattle ranching activity that was dependent upon federal rangeland in one sector, the dependence of this activity upon the remaining businesses in the County, and the dependence of the other businesses upon the ranches with federal grazing, could be illustrated.

Historical Development of Input-Output Analysis

While the basic framework for interindustry analysis was probably provided by Francois Quesnay with his Tableau Economique' in 1758, the inspirational debt must be paid to Leon Walras who published in 1877. The Walrasian system designated the interdependence among productive sectors of the economy in terms of the competing demands of each industry for productive factors, and the degree of substitution among their respective outputs in consumption (5).

Walras was interested in the simultaneous determination of all prices in the system; his model was a system of equations, one for each price to be determined. He subsequently derived "coefficients of production" which, being determined by technology, measured the

quantities of factors required to produce one unit of each type of finished product (18).

The consummation of these early developments was accomplished by Wassily Leontief who started research on the structure of the American economy in 1931 and presented an empirical model of interindustry dependence. Leontief's approach was to simplify the Walrasian system so as to derive a set of parameters for his model from a single observation of each of the interindustry transactions in the economy. He also used the original Walrasian fixed coefficients so that substitution among inputs was not possible. By eliminating all effects of price on the composition of consumer demand, on the purchase of intermediate goods, and on the supply of capital, labor and other factors, the Leontief model precludes many of the adjustments characterizing the Walrasian concept of general equilibrium (5).

Interindustry Theory

Since input-output analysis is concerned with the flow of goods and services associated with production processes, a transactions, or trade, matrix is constructed which depicts these flows. Table V presents an abbreviated version of a transactions matrix.

All production activities in the selected economy are grouped into sectors. In this hypothetical case, four sectors are shown.

TABLE V. A HYPOTHETICAL TRANSACTIONS MATRIX.

		Purchasing					
		1	2	3	4	Y_i	X_i
Selling	1	x_{11}	x_{12}	x_{13}	x_{14}	Y_1	X_1
	2	x_{21}	x_{22}	x_{23}	x_{24}	Y_2	X_2
	3	x_{31}	x_{32}	x_{33}	x_{34}	Y_3	X_3
	4	x_{41}	x_{42}	x_{43}	x_{44}	Y_4	X_4
	V_j	V_1	V_2	V_3	V_4	V_j	V
	X_j	X_1	X_2	X_3	X_4	Z	X

This is similar to a double-entry type of accounting scheme where each sector is a producer of output, and a purchaser of inputs. The x_{ij} elements in each row show how the product of the four sectors along the left side was disposed of in the processing portion of the matrix (columns 1 - 4). Since the sectors across the top of the table contain the same firms as the sectors along the left side, the x_{ij} elements in each column 1 - 4 show the dollar value of purchases from within the same sector, as well as from the remaining three sectors, for any of the four sectors across the top.

Thus the 4 x 4 sub-matrix forms the "processing" portion of the larger matrix. This is where the purchase of intermediate goods used in producing X_j (j = 1 - 4) dollars of total output takes place. The sum of intermediate purchases for the j^{th} sector is given by:

$$\sum_{i=1}^{4} x_{ij} \qquad (1)$$

where: i represents a specific row out of a total of n rows (in this case 4) and j represents a specific column out of a total of m columns (in this case 4).

The quantity V_j (j = 1, 2, 3, 4) represents the purchases of primary inputs used in producing X_j. Primary inputs are represented by payments to households in exchange for labor,[7] payments to governmental agencies in exchange for services rendered, profits, interest payments, depreciation allowances for consumption of capital equipment,[8] negative inventory change, and the value of imports. These are usually grouped together and labeled primary inputs, or value added (5).

It will be noticed that there is an X representing the sum of each row, and of each column. These two sums are identical for each of the sectors. This is a manifestation of Euler's Theorem which asserts that in the absence of economies of scale the distributive shares exactly equal the total product. Here X_i represents the total product of the i^{th} industry. Payments to intermediate factors is represented

[7] The matrix may be "closed" with respect to households in which case the household sector would appear in the processing portion of the matrix.

[8] Static models such as the one used here allow for depreciation as a primary input; dynamic models which are much more sophisticated allow for depreciation in the processing portion of the model.

by the sum

$$\sum_{i=1}^{4} x_{ij} \qquad (2)$$

for each of the j industries. Payments to primary factors by each of the j industries is represented by V_j. Hence, payments to the factors exhaust the total product and $X_i = X_j$ for $i = j$.

The quantity Y_i represents final demand, or final use, of the products of the i^{th} sector. These are sales of products or services which will not be used for the further production of other goods and services. The difference between total output (X_i), and final demand (Y_i), is the quantity of that sector's goods which were sold within the processing sector to assist in further production. This quantity is represented by:

$$\sum_{j=1}^{4} x_{ij} \qquad (3)$$

While the dollar flows represented by x_{ij} are informative, a more lucid picture is revealed by deriving the input-output, or technical, coefficients. These represent the proportion of every dollar of output produced that is spent for the respective inputs of each sector. Coefficients are derived for the processing portion of the matrix only. Their derivation is as follows:

X_j = total value of output of j^{th} sector

x_{ij} = value of purchases by the j^{th} sector from the i^{th} sector

then $x_{ij}/X_j = a_{ij}$ (4)

where: a_{ij} = share of every dollar of j's output which is spent in the i^{th} sector for intermediate goods and services. This coefficient shows the direct dependence of each of the economy's sectors upon the other sectors in the economy. These coefficients comprise the matrix of technical coefficients which has the dimensions 4 x 4 and is denoted by the letter "A".

With the transactions matrix showing dollar flows, and the technical coefficient matrix showing direct dependence in the economy, a substantial quantity of information is made available concerning the interdependence of the economy. The information is however, entirely descriptive.

The Input-Output Model as a Predictive Device

Most economists are not satisfied with mere description; it is the future events which are of concern, especially in macroeconomic analysis. With special qualifications, the input-output model can be utilized as a predictive tool to assist in the planning and development of both developed, and underdeveloped economies.

There are several opinions among researchers concerning the applicability of input-output models as predicting tools. Chenery and Clark (5) warn that the models have demonstrated only limited value in this use. Miernyk (18) on the other hand, as well as Almon (1) discuss "consistent forecasting" with relative

confidence.[9] This type of forecast insures that the summation of the individual industry projections will equal the projected G. N. P.

While "consistent forecasting" insures that the sum of the parts equals the whole, it seems that the real value in predicting with input-output is, that because of the high degree of disaggregation, it is possible to be fairly specific about changes in each of the sectors. This is particularly beneficial to the study of natural resource development in that potential beneficiaries might be identified.

The technique of predicting with input-output models can best be illustrated in equation form. Equation (5) presents the input-output system with its only variable, namely output, being dependent upon the parameters final demand, and input-output coefficients. Equations (5) through (14) trace the solution of the model, and the derivation of the inverse matrix of which is the first step in making a projection.[10] The inverse matrix, or matrix of direct and indirect coefficients, shows the total change in required purchases of one sector from all other sectors, for a one-dollar change in final demand of that one sector. If for example, the output of sector 1 is increased (increases or decreases are manifest as changes in final

[9] When a transactions matrix is projected, "the output of each industry is consistent with the demands, both final and from other industries, for its products" (1, p. 2).

[10] For a more exhaustive treatment of input-output solutions see: Dwyer (10), Chenery and Clark (5), and Evans (11).

demand), it will in turn buy more inputs from all other sectors. As these other sectors sell more of their output to sector 1, they will need to buy more from their suppliers. The matrix of direct and indirect requirements details how much this change would be from a dollar change in final demand.

The input-output system can be expressed as:

$$X_i = \sum_{j=1}^{m} a_{ij} \quad X_j + Y_i \qquad (5)$$

or as

$$X_i - \sum_{j=1}^{m} a_{ij} \quad X_j = Y_i \qquad (6)$$

where: X_i represents total output of the i^{th} sector

$\sum_{j=1}^{m} a_{ij} \quad X_j$ represents total intermediate demand in the i^{th} sector as depicted by the processing sector

Y_i represents final demand in the i^{th} sector

Rewriting these two equations in matrix form yields:

$$X = AX + Y \qquad (7)$$

and

$$X - AX = Y \qquad (8)$$

where: X represents a column vector of outputs for the economy

AX represents the n x m matrix of structural coefficients post-multiplied by the column vector of outputs

Y represents final demand

With I representing an identity matrix,[11] X can be multiplied times I (since IX = X) yielding:

$$IX - AX = (I - A)\,X = Y \qquad (9)$$

The quantity (I - A) in equation (9) represents what has come to be known as the "Leontief matrix;" all elements in the principle diagonal are positive while all other elements are negative. It is found by:

$$\begin{matrix} (1 - a_{11}) & - a_{12} & - a_{13} & \cdots & - a_{1n} \\ - a_{21} & (1 - a_{22}) & - a_{23} & \cdots & - a_{2n} \\ - a_{31} & - a_{32} & (1 - a_{33}) & \cdots & - a_{3n} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ - a_{m1} & - a_{m2} & - a_{m3} & \cdots & (1 - a_{mn}) \end{matrix} \qquad (10)$$

To get a solution to the system an inverse must be obtained of the above matrix. This is comparable to the algebraic process of division, or multiplication by a reciprocal. To solve (I - A) X = Y divide through by (I - A) which is the same as multiplying by its reciprocal 1/ (I - A) yielding:

$$X = [\,1/(I-A]\ [\,Y] = [\,(I-A)^{-1}]\ [\,Y] \qquad (11)$$

[11] An identity matrix is one in which all elements are zero except those in the principle diagonal i. e. starting in the upper left-hand corner and proceeding diagonally to the lower right-hand corner. The elements in the principle diagonal are ones.

The computer process necessary to find 1/(I-A) is called matrix inversion and yields an inverse matrix noted as A^{-1}. This new matrix is also noted as R by Chenery and Clark; the elements in R being noted by r_{ij}.

Equation (11) yields a solution to the system. To project a new level of output for the system, the final demand is changed and the system is solved again.

To solve the system now it is a simple matter of:

$$\hat{X} = [(I-A)^{-1}] \; [\hat{Y}] \tag{12}$$

or

$$\hat{X} = (R) \; (\hat{Y}) \tag{13}$$

where: $\hat{X}$ = projected output

$\hat{Y}$ = projected final demand

To illustrate this, the column vector of projected outputs is found by post multiplying the R matrix times the column vector of new estimates of final demand.

$$\begin{bmatrix} r_{11} & r_{12} & r_{13} & \cdots & r_{1n} \\ r_{21} & r_{22} & r_{23} & \cdots & r_{2n} \\ r_{31} & r_{32} & r_{33} & \cdots & r_{3n} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ r_{m1} & r_{m2} & r_{m3} & \cdots & r_{mn} \end{bmatrix} \begin{bmatrix} \hat{Y}_1 \\ \hat{Y}_2 \\ \hat{Y}_3 \\ \cdots \\ \hat{Y}_m \end{bmatrix} = \begin{bmatrix} \hat{X}_1 \\ \hat{X}_2 \\ \hat{X}_3 \\ \cdots \\ \hat{X}_m \end{bmatrix} \tag{14}$$

Assumptions of Input-Output Models

The input-output model requires several assumptions. First, it must be possible to form the productive sectors in such a way that a single production function can be assumed for each. In conjunction with this, the function must be linear, i. e. represent constant returns to scale. A third general assumption of interindustry models concerns the factor market and requires that there be perfect complementarity between inputs and/or constant price ratios between and among the various factors.

In addition to these general assumptions the Leontief input-output model also requires several special assumptions which are not made in other interindustry models. The most important of these are: (1) that a given product be supplied by one sector only; 2) that there be no joint products; 3) that the quantity of each input used in production by any one sector be determined entirely by the output of that sector; and 4) that the total effect of carrying on several types of production is equal to the sum of the separate effects. This last assumption is the additivity assumption which rules out external economies and diseconomies (5). One final assumption which violates Keynesian convention is that in the "open" model with respect to households (where the household sector is exogenous), a consumption function is irrelevant since consumption (which is part of final demand) is independent of output, employment and thus income;

consumption is an independently determined parameter (3).

These assumptions make it possible to accept equations (5) or (6) as simplified production functions for the economy being considered.

Following these general assumptions of input-output models, some specific assumptions concerning the use of the model as a forecasting tool must be made. One of the major weaknesses of forecasting is the necessity of assuming that the structural relationships, as depicted by the technical coefficients, will remain unchanged. Two factors may cause the coefficients to change: (1) change in the demand for a sector's product or service, and 2) change in technology. Both of these would cause a change in the relative prices of inputs and would therefore change the purchasing patterns of the County's businesses. Dynamic models allow for these changes by incorporating flexibility of the technical coefficients. This is not a simple matter however and requires much more data and refinement of technique than the static models such as will be used here.

Sectoral Design

The final theoretical concept to be discussed is the method by which the various sectors are compiled. The construction of the transactions matrix is the most exacting aspect of the model design. Not only are the data requirements formidable, but the way in which

the businesses are aggregated to form the matrix is very important.

According to Chenery and Clark (5) the original Leontief sector was, like the Marshallian or Walrasian industry, assumed to be composed of plants producing a single homogeneous product by very similar techniques. If this strict aggregation were attempted only those plants with both input and output structures very similar would be grouped together to form an industry. This method obviously would not be satisfactory for a national model nor was it feasible in this model.

A somewhat more practical basis of aggregation for empirical interindustry studies is that of grouping both processes and products which differ in some minor respects. As is pointed out by Chenery and Clark (5), the actions of such a group need only be uniform with respect to the characteristics used as a basis for aggregation.

If at all possible it appears that the most satisfactory basis for aggregation for most types of input-output models is similarity of input structure. Here, a change in the goods produced by a sector will have no affect upon the inputs required from other sectors. However, because of the availability of secondary data it usually follows that aggregation is based on the grouping of substitutes. Such aggregation will exhibit instability of input coefficients unless the productive processes also have similar inputs. The aggregation of substitutes has the effect of using a weighted average of their respective

input coefficients which results in the same effect upon other industries as keeping the two separate. In fact, if the model is being constructed for the express purpose of demand impact upon the economy then it is most desirable to have substitutes in separate sectors (5).

Since perfect aggregation can never be achieved, it is often desirable to specify the objectives of the analysis in advance and then aggregate accordingly. A case in point is the national model which has combined forest products and fisheries into one sector. Certainly if undertaking the task of empirically determining the significance of the forest products industry in a region, or even in the nation, such an aggregation would be somewhat less than desirable.

Regional Input-Output Models

Since input-output models are effective means to show trade relationships, their use in natural resource economic problems provides an opportunity to show the results of development projects and the distribution of secondary benefits. The interest in this type of work is more on a regional basis rather than national and thus recent growth of regional models is a considerable aid in establishing trade relationships in an economy such as that of Grant County. The regional model is usually similar to a national model; the only difference being the area covered.

Selection of regions that lend themselves to an analysis of this type must proceed cautiously as there are certain requirements that must be met. First it is desirable if the region coincides with certain political boundaries. This is of considerable value in that published sources of data may be utilized as a check for accuracy. Second, it is desirable if the region is reasonably self-sufficient economically speaking. This is required because if an area exports a large percentage of its products, and imports the majority of its resources, there exists very little interdependence among the area's business firms. This dependence is reflected in the magnitude of the "technical coefficients" which show the value of factors purchased from the other businesses in the region for every dollar of output from any one industry. The precise meaning of these coefficients will be discussed in the following chapter.

Miernyk (18) points out that regional models are more "open" than their national counterpart. This is explained by the fact that exports and imports play a rather minor role in the national economy but with some regions these can be of considerable significance. This is in line with the previous paragraph where the importance of a more or less self-contained economy was discussed. Regions tend to capitilize on their comparative advantage thus leading to a high degree of specialization and exchange between regions.

The major drawback to regional models is the difficulty in

obtaining data for the transaction table. This often leads to less accurate estimates of the total output of the region than if there existed secondary information to correlate with. Grant County contains a relatively small number of commercial enterprises (288) and this made it easier to obtain knowledge about the relative sizes of unsampled firms. This was of considerable aid when it came time to expand the sample data to arrive at figures for the entire population of businesses.

Because of data limitations, many of the published regional models to date have utilized the national coefficients to show sectoral dependence and estimated sector output from other secondary sources. Some of them have modified these coefficients as the analysts saw fit. This was necessary because of the different nature of some of the sectors in the regional model from those in the national model. Moore and Peterson (20) used the national coefficients as a first approximation and then, with the knowledge of differences in regional productive processes, product-mix, and industry-mix, modified the national coefficients accordingly. Their work on the Utah economy has been credited with making a major contribution towards increasing the applicability of national coefficients for use in regional, or other small area models.

Two recent publications by Lund (16, 17) are what might be considered regional in scope as they cover four Southwestern Wyoming

counties of a combined area of approximately 22, 000 square miles, or one-fifth of the state. Lund and his co-workers utilized published secondary data as well as conducting almost 800 interviews with operators of the area's commercial businesses. This work is one of the very few published to date that does not use national coefficients. When one considers the high cost involved it is obvious why more regional models are not constructed in a similar manner.

Stoevener in his work at Yaquina Bay, Oregon (27, 28) is concerned with a very small, but somewhat self-sufficient economy. This research was initiated to evaluate various water pollution control alternatives and the resultant ramifications upon the local economic environment. Some of the conceptual problems in such an undertaking may be imagined when it is realized that the study covers only a fraction of one county and is concerned with two communities in this small area. Here it is almost impossible to obtain secondary data to check that obtained through interviewing. Approximately one-third of the business enterprises in the area were sampled as well as a portion of the area's households.

Application of Input-Output Models to Natural Resource Problems

The identification of potential beneficiaries from natural resource development projects is receiving considerable attention in the literature. Benefit-cost analysis has long been the only tool utilized to

measure the magnitude of potential benefits. With the use of input-output models the distribution of these benefits is made known. As was recently pointed out by Stoevener and Castle (29), the model's ability to depict the flow of goods and services through an economy may be the only way to account for all changes in output which give rise to secondary benefits.

Secondary benefits are defined as the increase in value of goods and services which indirectly result from the project, net of any nonproject costs incurred to realize these benefits (13). These benefits accrue to the businesses and individuals in the region. The reason for their identification is manifest in the actions of local groups to attract development projects such as multipurpose dams. Chambers of Commerce are well aware of the local benefits from such development projects and are often leading the campaign to attract such development. It is obvious that the marginal local benefits exceed the marginal local costs of development. The local beneficiaries are not paying their proportionate share of the costs in relation to the benefits they receive.

The input-output model traces the change in output throughout the entire economy being studied. The matrix of direct and indirect coefficients relates these changes in output of one or several sectors, to all other sectors in the economy. Through the identification of those sectors which will profit the most from development projects,

a broader base from which to help defray development costs might evolve. If this were done, more development projects, or more extensive ones, might be possible with the same level of public expenditure (13).

This concept will be discussed in more detail in Chapter VI where the effects of a change in the quantity of federal grazing carried on in the County will be detailed to show the magnitude of secondary benefits resulting from these changes in grazing.

The same concepts are being utilized in the water quality field. The work by Stoevener mentioned previously is attempting to relate changes in water quality to the impact upon the economy of the area from a change in recreational use.

IV. IMPLEMENTATION OF THE MODEL

The first step in constructing a model for an area is the aggregation of all business firms into the sectors. These sectors then become synonomous with "industries," that is, the lumber industry etc. The aggregation used in the Grant County model parallels somewhat that utilized by Stoevener in his model for the Yaquina Bay, Oregon area.

Table VI shows the sectors as defined in the model and the subsectors within each. Sector 1, entitled "Dependent Cattle Ranches," consist of all cattle ranches with headquarters in Grant County which are dependent to varying degrees upon federal range for seasonal forage supplies. Sector 2 consists of all other agricultural producers in the County, none of whom hold federal grazing privileges.

These two sectors were compiled with the assistance of the Grant County Extension Agent, and from the files of the Bureau of Land Management and the Forest Service. Only those producers who received at least one-half of their gross income from agricultural pursuits were included in these two sectors.

The twelve commercial business sectors were compiled following the listing of all businesses in the County's telephone directories. This list was supplemented through discussions with the manager of the John Day Chamber of Commerce and by checking all roads in the

TABLE VI. GRANT COUNTY BUSINESSES, 1964.

Sector	Sub-Sector	
a) Dependent cattle ranches	Cattle ranches with Forest Service or Bureau of Land Management grazing privileges	
b) Other agricultural producers	All other farmers and ranchers	
c) Lumber	Lumber mills Logging Lumber Trucking	
d) Mining		
e) Lodging	Hotels Motels Trailer Parks	Apartments Resorts
f) Cafes and Taverns		
g) Agricultural services	Feed, Seed and Farm Machinery	
h) Automotive sales and services	Gas and oil distributors Service stations Auto repairs Auto sales	Tires Auto supplies Machine shops
i) Communications-Transportation	Radio stations Newspapers Trucking Western Union T. V. Cable	Bus Railroad Telephone Aircraft
j) Professional services	Physicians & Dentists Attorneys Optometrists Veterinarians	Accountants Hospital
k) Financial	Banks - Loan Agencies	
l) Construction	Lumber-Retail Contractors Hardware	
m) Product oriented Wholesale and retail	Groceries Clothing - Shoes Furniture - Appliances Dept. and Variety Drug Stores Florists	

TABLE VI. (cont.)

Sector	Sub-Sector
m) cont.	Machinery Dealer Jewelers Office Supplies Electricity and gas All other (Dairy, Photo, Sears, Montgomery Wards, Liquor Store, Saw Shop, etc.)
n) Service oriented Wholesale and retail	Barber and Beauty Shop Insurance and Real Estate Laundry and Cleaning Non-profit organization (Churches, Elks Club, etc.) Entertainment (movies, golf, bowling) Saddle-maker Garbage disposal Other repairs (Gunsmith, etc.) Undertaking All other (Credit Bureau, Chamber of Commerce)
o) Households	All private individuals

County as well as all streets in every community for businesses that might have been overlooked. When the complete list of all commercial businesses was acquired they were categorized into one of the twelve business sectors. To insure complete coverage of the diverse business activities in some of the sectors, the businesses were subdivided into more homogeneous sub-groups and each of these was sampled.

Selection of Sample

Two different sampling procedures were utilized to obtain data from the 14 sectors.

The Two Agricultural Sectors

Because of a time constraint it was necessary to utilize mailed questionnaires for the two agricultural sectors. With the assistance of the County Extension Agent, the President of the Oregon Cattlemen's Association and the Grant County Stockgrower's Association, a questionnaire and cover letter explaining the research was sent to all agricultural producers in each sector. After several weeks a reminder letter was sent out. Following this, all those who had not responded received another letter with a new questionnaire enclosed. At this same time a telephone campaign was initiated by the County Agent and the President of the Grant County Stockgrowers to encourage all those who had not responded to please do so.

In view of the efforts expended, the return was somewhat discouraging. The "Dependent" sector returned 42 percent of their questionnaires (61 out of 143), and the "Other Agriculture" sector returned 18 percent of theirs (15 out of 82). Through knowledge of the relative sizes of operations in both sectors it was possible to determine the extent of non-response bias. Through weighting it was

possible to allow for this bias in "blowing up" the sample data to population totals.

Because of a difference in definition, the total number of agricultural producers in the County (both sectors) differs from that listed in the 1959 Census of Agriculture. The Census lists 331 farms in the County for that year (31). The number utilized in this research was 225. In line with the aggregation carried out in the commercial business sectors, the firm is categorized by that activity or product sold which yielded at least half of the total gross receipts. As a result, those farms and ranches owned and operated by persons with other occupations providing more than half of the gross income were not included in the agricultural sectors in this research. Thus the discrepency from Census figures.

The Twelve Commercial Sectors

Data from the remaining twelve sectors was obtained through personal interviews with the proprietor or manager. First, all firms in each subsector were arranged in alphabetical order. Because there was no reason for believing firm characteristics to be correlated with alphabetical ordering, systematic random sampling was used; it was felt that this procedure would provide good coverage of the entire population.

For each subsector of size N_i, with a sampling goal of 25 percent,

a number between 1 and N_i was selected from a random number table. From this starting position, every k^{th} firm was selected ($k = N_i/n_i$ where n_i = 25 percent of N_i). Because some subsectors had very few firms, a greater sampling percentage than 25 percent was achieved in a considerable number of subsectors. As a result, some of the sectors were sampled at greater than 25 percent also. The overall sampling percentage was 29.6 percent (34 percent for two agricultural sectors, 28 percent for the commercial sectors).

Through discussions with the manager of the John Day Chamber of Commerce and others in the County, adequate information was obtained on relative volume of sampled to unsampled firms that the expansion from sample, to population totals was done with a considerable degree of confidence.

Gross Sales

Because of the degree of aggregation in the model it is instructive to detail what comprises the gross sales of each of the sectors.

Agricultural Sectors

Total output (sales) of both agricultural sectors consists of all income received from all ranch sales (crops, livestock, livestock products, timber, machinery, services rendered, and rental income if the rental was a business proposition).

Lumber Sector

The lumber sector consists of three subsectors, each of which must be dealt with separately.

There are six commercial lumber mills in Grant County all of which process logs harvested within the County. The processed logs are then hauled out of the County as cut lumber to either Burns, Baker, Pendleton, or Prineville. The total "output" of the lumber mill subsector is the value of processed lumber shipped out by these six mills. In addition to this, any other receipts received by the mills for products or services rendered is included.

The "logging" subsector is, as is the "hauling" one, fairly self explanatory with gross receipts in the former representing all income from services rendered in the harvest of timber, and in the latter, the total receipts from the hauling of said harvested timber from the forest to the respective mills, or from the mills to shipping points outside of Grant County.

Mining

The mining sector is characterized by complete absentee ownership and all minerals are shipped out of the county without any processing. Thus the output of the county's "mining industry" is represented by the published data on mineral shipment. Employment data

and payments to households was obtained through the Oregon Employment Security Commission. In 1964 there were four separate mining operations or units in the County employing ten people. The method of using the published value of the County's mineral production was one employed by Lund in Wyoming where large mineral exploration companies maintain a minimum of local management personnel and run the operation from a distant main office. The minerals shipped from Grant County are stone, sand and gravel, mercury, copper, gold, silver, zinc, and lead (37).

Lodging - Cafes and Taverns

Total output of these two sectors is represented by the gross sales of their respective services.

Agricultural Services

The Agricultural Services sector consists solely of feed and seed stores and those that sell farm machinery. The agriculture of Grant County is such that there is no need for processing firms for the locally grown farm products. The County is also isolated enough so that there is no importation of "foreign-grown" agricultural raw materials for processing. A livestock slaughter and packing house now in operation in Long Creek, was operating until the early part of 1963, but was closed during all of 1964. Total output of this sector

is the value of gross sales of its members.

Automotive

The Automotive sector includes all motor vehicle related activities except truck lines. Its output is represented by the gross receipts of wholesale gas and oil distributors, retail service stations, new and used automobile sales, auto supplies, repairs and tires, and machine shops.

Communications and Transportation

The Communications and Transportation sector is admittedly quite heterogeneous but nonetheless supports retail and wholesale trade in the County in a somewhat similar manner. The "output" of this sector is such that some explanation seems justified for each of the sub-sectors. Radio stations sell advertising time to commercial enterprises. Thus the output of this subsector is represented by receipts from the County's commercial businesses in exchange for advertising time.

There are three newspapers in the County; one local weekly paper, and two that come from Portland. The local paper receives income both from subscriptions as well as from the sale of advertising space to local businesses. The Portland papers receive income from subscriptions or counter sales only. Thus gross output is the

summation of these various sources.

There is only one licensed common carrier in Grant County and his output is represented by the gross receipts received from businesses and households in exchange for hauling goods to, within, and from the County.

Western Union, the T. V. Cable company, and the telephone companies all receive income in exchange for a service rendered. This service includes not only telephone service or television reception, but also rental of lines and equipment to various outlets. The gross output of these subsectors is the receipts credited to the respective offices within Grant County.

The aircraft subsector consists of the privately run John Day Airport. There is no commercial service to John Day so the major part of the operation's income comes from the renting of both pilot and plane by local businessmen and governmental agencies.

Professional

The professional sector is comprised of doctors, lawyers, veterinarians, accountants, and the Community Hospital. The hospital is operated by the County and receives funds from the general tax fund of Grant County.

Financial

The Financial sector consists of banks and loan agencies. Their gross output is represented by interest collected, service charges, and the income generated by capital reserves, and investments.

Construction

The Construction sector is comprised of two types of firms: 1) actual contractors and 2) outlets for construction materials. The contractor subsector consists of both large, heavy construction companies which are involved with road work, land leveling, and related activities; and the smaller type of construction work which involves primarily house and office building, and plumbing and electrical contractors. The hardware subsector is primarily engaged in supplying both households as well as contractors with the needed materials for construction activities. This does not include the city version of a hardware store which stocks many small items, but the stores are typical of rural areas and are a conglomeration of the city's hardware and lumber stores.

Products

The Product sector is a somewhat heterogeneous mixture of businesses, both wholesale and retail, which sell products both to

other businesses as well as to households. The gross output of this sector represents the summation of all of the individual sales of each of its members.

Services

The Service sector consists of all firms and organizations that do not sell a definable product as their primary output but rather render a service to their customer. The output of an insurance agent in the County is represented by the magnitude of the percentage he receives from the company he represents as an agent. The output of the local churches, although it may sound somewhat sacrilegious, is represented by the total receipts of these organizations in exchange for the service rendered by them. The remainder of the service oriented firms have incomes that need no explanation here.

There are only two commercial activities knowingly excluded from the model; a bus line and a short railroad. A desk clerk at one of the John Day hotels acts as ticket agent for the bus line and since all of the collected revenue leaves the County it would manifest itself as an imported service.

The railroad belongs to the Edward Hines Lumber Company of Hines, Oregon (adjacent to Burns) and serves the function of hauling logs and/or cut lumber from Seneca to Hines. Hines Company has a mill at Bates in the eastern part of the County and the cut lumber

is hauled by truck from Bates to Seneca where it is loaded on the railroad for the trip to Hines' mill at Hines. The total length of the railroad is approximately 44 miles of which only 15 lies within Grant County. The road does haul some livestock to Burns as well as other small shipments of freight. Since the majority of its cargo is lumber being shipped by one company for its use at another location, it did not seem proper to include the "output" of the line in the traditional fashion.

V. THE ECONOMY AS PORTRAYED BY THE INPUT-OUTPUT MODEL

Transactions Matrix

The transactions matrix for Grant County is presented in Table VII. It illustrates the flow of money in the economy. The same "industries," or sectors, appear along both the top and the left side. Those listed across the top made purchases from those listed along the side and similarly those along the side, sold to the sectors listed across the top of the table. The figures in the cells represent money flows (in exchange for goods and services) from sectors across the top to sectors along the side. Thus sector 1, Dependent Ranches, purchased $42,713 from itself (intrasector trade), $41,529 from the Other Agricultural producers, nothing from the lumber or mining sectors, $1,680 from the Lodging sector, nothing from the Cafes and Taverns, $197,982 from the Agricultural Services sector and so on down the first column. It should be pointed out that these dollar flows represent only intermediate goods in the strictest economic usage; all purchases are used as an input in the productive process of the industries across the top. There are no purchases by, say, ranchers for their personal use. Only business expenditures are recorded.

Not only can the purchases by the respective sectors be traced

TABLE VII. TRANSACTIONS MATRIX SHOWING INTERINDUSTRY FLOWS IN DOLLARS, GRANT COUNTY, OREGON, 1964.

SALES	(1) Dependent Ranches	(2) Other Agriculture	(3) Lumber	(4) Mining	(5) Lodging	(6) Cafes and Taverns	PURCHASES (7) Agricultural Services	(8) Automotive	(9) Communicatic and Transportation	(10) Professional	(11) Financial	(12) Construction	(13) Products	(14) Services	(15) Households	(16) Government	(17) Exports	(18) Capital Formation and Positive Inventory Change	(19) Total Output
(1) Dependent Ranches	42,713	76,373	42,570	0	572	0	1,716	0	0	0	572	715	11,583	572	1,430	54,641	3,084,097	403,689	3,721,243
(2) Other Agriculture	41,529	17,278	1,722	0	0	0	0	0	0	0	0	0	574	5,740	492	48,034	836,869	114,060	1,066,298
(3) Lumber	0	0	1,154,776	0	0	0	0	0	0	0	0	0	0	0	43,200	3,000	12,567,000	118,694	13,886,670
(4) Mining	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	358,000	0	358,000
(5) Lodging	1,680	1,200	4,488	0	0	0	0	0	1,200	0	0	4,350	0	0	27,960	66,600	306,050	2,000	415,600
(6) Cafes and Taverns	0	0	0	0	0	0	0	0	0	0	0	0	0	0	457,600	0	305,900	0	763,500
(7) Agricultural Services	197,982	37,926	45,000	30,000	15,000	0	0	0	0	0	0	0	0	0	15,000	0	0	43,092	384,000
(8) Automotive	991,910	201,120	1,088,086	10,089	85,280	22,570	8,554	1,113,889	104,497	0	78	72,793	32,914	29,329	2,603,201	552,632	902,578	207,757	8,027,277
(9) Communication and Transportation	1,735	517	43,750	692	4,044	3,586	3,076	99,497	21,855	12,415	4,723	9,605	108,931	14,865	201,631	33,146	513,889	10,496	1,088,453
(10) Professional	73,321	41,243	11,670	0	2,670	2,370	0	7,700	2,970	450	900	2,400	24,026	8,550	746,882	119,870	62,596	2,500	1,110,118
(11) Financial	113,816	30,256	72,036	0	1,566	1,566	0	0	9,396	0	0	12,528	15,439	6,264	53,244	126,720	0	480,000	922,831
(12) Construction	33,829	5,839	3,440	1,720	0	5,760	0	0	200	0	0	8,600	3,440	0	139,627	376,155	25,783	175,742	780,135
(13) Products	181,571	63,926	749,265	5,876	47,326	347,846	5,302	65,929	49,429	17,428	3,909	83,861	633,955	43,033	7,260,812	283,039	1,787,672	182,306	11,812,485
(14) Services	112,453	49,617	87,521	0	33,015	37,746	114	16.746	900	4,272	385	1,335	36,888	0	557,693	8,689	50,861	4,584	1,002,819
Summation	1,792,539	525,295	3,304,324	48,377	189,473	421,444	18,762	1,303,761	190,447	34,565	10,567	196,187	867,750	108,353	12,108,772	1,672,526	20,801,295	1,744,920	
(15) Households	363,792	190,650	4,180,952	70,907	72,700	233,161	36,000	800,805	457,309	544,832	134,040	130,227	1,097,451	403,399		1,622,440			
(16) Government	463,636	126,216	167,374		30,262	6,682	3,600	37,906	102,289	8,835	27,965	3,624	371,218	36,627					
(17) Imports	380,556	35,537	5,798,908		11,741	87,716	316,638	5,819,541	229,091	438,514	747,019	429,877	9,138,001	355,059					
(18) Depreciation and Neg. Inv. Changes	720,720	188,600	435,112		111,424	14,497	9,000	65,264	109,317	83,372	3,240	20,220	338,065	99,381					
(19) Total Inputs	3,721,243	1,066,298	13,886,670	358,000	415,600	763,500	384,000	8,027,277	1,088,453	1,110,118	922,831	780,135	11,812,485	1,002,819					45,339,429

down the columns but the same sector's sales can be described by reading across the row in question. Again using Dependent Ranches as an example, their sales were $42, 713 of intrasector trade, $76,373 received from the Other Agriculture sector, $42, 570 received from the Lumber sector, and so on across row 1. The first 14 rows and the first 14 columns in the matrix represent the processing sector of the larger matrix and are similar to a double-entry type of bookkeeping system wherein every sale and purchase is accounted for.

Although it is only the processing portion of the matrix that is used in computing the matrix of technical coefficients, the entries both in rows below the processing portion, and the columns to the right of the processing portion, contain information that is useful in describing the economy.

Row 15, labeled Households, represents that amount of money paid to individuals by the industries and government across the top of the table in exchange for labor and entrepreneurial services. The row labeled Government (16) represents that amount of money received by both local (county or city governments) and state and federal agencies in the form of taxes, fees, licenses etc. from the respective businesses across the top of the matrix. The Imports row (17) is the amount of "leakage" from the economy in the form of imported products and services by the sectors across the top of the table. The magnitude of these imports indicate the degree to which

the Grant County economy is not self sufficient. Row 18, Depreciation and Negative Inventory Change, shows the magnitude both of the amount allocated each year by the respective businesses for capital consumption, and the extent of depletion of previously accumulated raw materials, intermediate goods, and/or finished products. Row 19 labeled Total Input represents the sum of all the entries in each column. It will be noticed that this figure for a given sector is identical with the corresponding sector's total output entry in column 19. The Imports figure is the only entry, except for total output of the Mining Industry and its wage payments, that was not obtained directly from questionnaires. Since, in the long run Euler's Theorem must hold, the sum of all entries in each column was subtracted from the respective sector output to derive Imports as a residual.

Referring now to column 15 labeled Households, the entries in this column refer to purchases made by households from the respective businesses listed across the left side of the matrix. Column 16 labeled Government reflects the value of goods and services purchased by local, state, and federal government agencies from the respective sectors along the left side of the table. Column 17, Exports, shows the magnitude of "basic income" generated by each of the industries along the left side of the matrix. The column labeled Capital Formation and Positive Inventory Change represents first, the amount of investment expenditures that were spent in purchasing

capital items from the sectors along the left side of the table, and secondly, the extent of accumulation of raw materials, intermediate goods, and/or finished products by the sectors along the left side of the table. Column 19, Total Output, shows the gross output of each of the sectors along the left side.[12]

These two portions of the matrix form the second and third major parts of the transactions table; rows 15 through 18 represent the "payments," "value added," or primary inputs portion and reflect the purchase of inputs not produced within the endogenous part of the model. As pointed out by Chenery and Clark (5), in a static model as was utilized in Grant County, the use of existing capital stock represents a primary input, just as does the use of land and labor. Thus the total payment to primary factors by each sector corresponds approximately to the value added in production.

Columns 15 through 18 represent the "final demand," or final use of goods and services, categorized by major type of usage. The

[12]It will be noticed that the sum of outputs (gross incomes) of the two agricultural sectors is greater than that figure published by the Statistical Reporting Service as the gross sales of Grant County farms and ranches in 1964 ($4,787,541 vs. $4,113,000). There are several reasons for the discrepancy. In addition to regular sales by ranches, the data collected for the model includes positive inventory change in the gross output. A second reason might be that the data here was for the calendar year 1964, while the S. R. S. figures are for the 1964 crop year. While most of the agriculture in Grant County is such that sales are made in the same year, it is possible that some divergence occurred because of this reason. Sampling inaccuracies account for the remainder of the divergence not explained by the above.

sum of the items in this portion is approximately equal to Gross "County" Product. In a national model, this portion is approximately equal to Gross National Product.

Technical Coefficients

While the dollar flows depict the purchasing and selling patterns of the economy's sectors, a more illustrative picture of interdependence is presented in Table VIII. These are the technical coefficients which were computed by:

$$a_{ij} = \frac{x_{ij}}{X_j} \qquad (15)$$

To determine the input mix of a sector one reads down the column of the sector under consideration. The coefficients represent that portion of each unit of output ($1.00) which is spent in the purchase of input from the sectors listed along the left side of the matrix. These coefficients reveal the dependence of a sector upon all other sectors of the economy. Using Dependent Ranches as an example, it is seen that for every dollar of output of the sector, its member firms purchased $0.01 (0.011478) worth of inputs from the other ranches in the same sector; $0.01 (0.011160) worth of inputs from the Other Agriculture sector; $0.0005 (0.000451) from the Lodging sector; $0.05 (0.053203) worth of inputs from the Agricultural Services sector; $0.27 (0.266553) worth of inputs from the Automotive

TABLE VIII. MATRIX OF TECHNICAL COEFFICIENTS, GRANT COUNTY, OREGON, 1964.

SALES		(1) Dependent Ranches	(2) Other Agriculture	(3) Lumber	(4) Mining	(5) Lodging	(6) Cafes and Taverns	(7) Agricultural Services	PURCHASES (8) Automotive	(9) Communication and Transportation	(10) Professional	(11) Financial	(12) Construction	(13) Products	(14) Services
(1)	Dependent Ranches	.011478	.071624	.003066	0	.001376	0	.004469	0	0	0	.000620	.000917	.000981	.000570
(2)	Other Agriculture	.011160	.016204	.000124	0	0	0	0	0	0	0	0	0	.000049	.005724
(3)	Lumber	0	0	.083157	0	0	0	0	0	0	0	0	0	0	0
(4)	Mining	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(5)	Lodging	.000451	.001125	.000323	.000201	0	0	0	0	.001102	0	0	.005576	0	0
(6)	Cafes and Taverns	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(7)	Agricultural Services	.053203	.035568	.003241	.083799	.036092	0	0	0	0	0	0	0	0	0
(8)	Automotive	.266553	.188616	.078355	.028182	.205197	.029561	.022276	.138763	.096005	0	.000085	.093308	.002786	.029247
(9)	Communication and Transportation	.000466	.000485	.003151	.001933	.009731	.004697	.008010	.012395	.020079	.011183	.005118	.012312	.009222	.014823
(10)	Professional	.019703	.038679	.000840	0	.006424	.003104	0	.000959	.002729	.000405	.000975	.003076	.002034	.008526
(11)	Financial	.030585	.028375	.005187	0	.003768	.002051	0	0	.008632	0	0	.016059	.001307	.006246
(12)	Construction	.009091	.005476	.000248	.004804	0	.007544	0	0	.000184	0	0	.011024	.000291	0
(13)	Products	.048793	.059951	.053956	.016413	.113874	.455594	.013807	.008213	.045412	.015699	.004236	.107495	.053668	.042912
(14)	Services	.030219	.046532	.006303	0	.079439	.049438	.000297	.002086	.000827	.003848	.000417	.001711	.003123	0
	Sum of 1-14	.481702	.492635	.237941	.134332	.455901	.551989	.048859	.162416	.174970	.031135	.011451	.251478	.073461	.108048
(15)	Households	.097761	.178796	.301076	.198064	.174927	.305384	.093750	.099760	.420147	.490788	.145249	.166929	.092906	.402265
(16)	Payments to Government	.124592	.118368	.012053		.072815	.008752	.009375	.004722	.093976	.007959	.030303	.004645	.031426	.036524
(17)	Imports	.102266	.033327	.417587		.028251	.114887	.824578	.724972	.210474	.395016	.809486	.551029	.773588	.354061
(18)	Depreciation and Neg. Inven. Changes	.193679	.176874	.031333		.268106	.018988	.023438	.008130	.100433	.075102	.003511	.025919	.028619	.099102

sector and so on down column 1. This process can be repeated for any of the sectors across the top of the matrix.

Economic Interdependence

With the presentation of the mechanics of reading the table, it is now possible to discuss some of the characteristics of the Grant County economy as revealed by the transactions matrix (Table VII) and the technical coefficients matrix (Table VIII).

Referring first to Table VII, it will be noticed that the majority of the cells in the first seven columns are either empty or contain relatively small entries. The reason is that the first six sectors are largely exporters, and the seventh is a large importer that in turn sells to very few of the other sectors in the economy. The two agricultural sectors export the majority of their output (cattle) to the feedlots of other counties or states (except for some intraindustry trade and a few minor sales). The Dependent Ranches sector exported 83 percent of its output, while the Other Agriculture sector exported 78 percent of its output. With this estimate of the magnitude of new money brought into the local economy, it is of interest to see how much of it was spent in intermediate production as compared to that of the other large exporter, lumber. The Dependent Ranches sector spent just less than half of every dollar ($.481702) earned, in the purchase of intermediate goods from Grant County's businesses.

The Other Agriculture sector, though accounting for but 22 percent of the total agricultural output of the county, purchased almost precisely half of every dollar ($. 492635) earned, in the acquisition of intermediate goods and services. Thus the two agricultural sectors taken together purchased $. 484137 from Grant County's businesses for every $1. 00 of output they sold. The total amount spent in the County by the two sectors was $2, 317, 826 of which the Dependent Ranches sector spent $1, 792, 530, or over 77 percent. The Other Agriculture sector spent $525, 296 for the remaining 23 percent.

The Lumber sector is the largest exporter both in absolute quantity and in percent of its output (90). At the same time it spent much less in the local communities per dollar of output (. 237951) than did either of the agricultural sectors. While its gross output is $13, 886, 670, because of its low "intermediate goods coefficient" it spent only $3, 304, 347 on the acquisition of intermediate goods from the county's businesses.

A sector which is exogenous in this model but one that deserves some discussion is the Household sector. Again the coefficients in this row reflect the purchase of labor and entrepreneurial inputs per dollar of gross income received by the respective sectors across the top of the matrix. For the most part these coefficients relate the degree of labor intensity of the various sectors.

Several interesting aspects of these coefficients may be noticed.

First, there is a considerable difference between the labor intensity of the two agricultural sectors. The Dependent Ranches sector pays a labor bill of less than $0.10 per dollar of gross sales as compared to almost $0.18 per dollar for the Other Agriculture sector. In view of the extensive nature of the former this difference might be expected.

The Lumber industry paid a little over $.30 of every dollar of gross income to Grant County residents for their labor and management services. The Mining industry $.20 of every dollar; the Communications and Transportation industry and the Professional Services sector paid $.42 and $.49 respectively per dollar of gross income; and the other large coefficient is of the Services sector with $.40 per dollar of sales. The significance of these particular coefficients is manifest when it is realized that for every dollar change in gross income of one of the sectors, household income changes by at least the amount of the coefficient for that sector.

Because the headquarters of the mining firms operating in Grant County are not located within the County, and because of the remote location of the mining activity, the sector has a low "intermediate goods coefficient" of .134332. The majority of the mining operations depend on non-Grant County sources for a large share of their supplies and thus their expenditures within the County are relatively small.

The Lodging sector is a large "exporter" in that the majority of its business (74 percent) comes from non-residents of Grant County. This basic income is then utilized to purchase intermediate goods from local businesses at the rate of $. 46 per dollar of income by the Lodging sector. Cafes and Taverns are also exporters of goods and services in a similar manner as the Lodging sector. Forty percent of the income of the Cafes and Taverns sector came from outside Grant County. For every dollar of income received by this sector, $. 55 was spent within the County for purchases of intermediate goods and services. While no attempt was made to specify the importance of the recreation "industry" to the County, these two sectors account for much of the business which comes from tourists, hunters and other non-County residents.

The Agricultural Services sector is, quite expectedly, a large importer of goods that are in turn resold to the agricultural sectors. The purchases of this sector from others within the County (and its sales to them) are minimal since it deals in unique merchandise which cannot be acquired within the County, and for which there is not a widespread demand.

The remaining seven sectors all participate in intersector trade to a greater degree than do the first seven. None is a particularly large exporter with the Communications and Transportation sector being the only one that receives anywhere near one-half of its income

from outside the County. Both the Automotive and the Products sectors are large importers as might be expected.

The foregoing has presented a quantitative description of the Grant County's economy. It is seen from the transactions matrix that the County's economic role is largely that of an exporter of raw materials. There is a conspicuous lack of any "value-adding" activities in the County. The two largest industries - livestock and lumber - export 82 percent and 90 percent respectively of their gross output; they are also the two activities most dependent upon public lands. These two facts make it obvious that federal land use policy is of extreme importance to the economic vitality of an area such as Grant County. To explore the results from a change in federal policy, secondary data was utilized which showed impact on ranch incomes from reductions in federal grazing. This will be discussed in Chapter VI.

VI. IMPACT UPON THE LOCAL ECONOMY FROM A HYPOTHETICAL CHANGE IN THE QUANTITY OF PERMITTED FEDERAL GRAZING

Reductions in the quantity of permitted federal grazing may come about for several reasons. One reason would be range conservation and rehabilitation. Another might be pressure from other uses or groups representing these uses. Reductions due to the latter cause would appear to be the most prevalent type in the future; the majority of the reductions for the former reason have been consummated.

Reductions because of use conflicts would not have an effect on all dependent ranches in Grant County; some would continue their operation unchanged, while others may be required to change considerably. Any discussion concerning these impacts upon ranch operation must necessarily proceed with many assumptions about the current ranching operations and the strategies which would be followed by ranchers in the face of a lesser quantity of available federal grazing.

Since the concern here is with the aggregate effects, the emphasis of the impact on individual ranch firms, will be minimized. A recent study sponsored by the Forest Service and the Bureau of Land Management will be utilized to arrive at gross ranch income changes from a 20 percent reduction in the quantity of permitted

federal grazing (4).[13] The 20 percent reduction is an arbitrary figure which was used in the study and will be utilized here to illustrate the technique of projecting with input-output as well as to give an indication of the impact upon the local economy from such a reduction.

There are four types of possible reductions: 1) a reduction in permitted numbers; 2) a reduction in length of grazing season; 3) a reduction in both; or 4) complete elimination of federal grazing. It should be emphasized that each of the different types of reductions would produce quite dissimilar effects on the ranch operation. Although every ranch will not be reduced 20 percent of its federal AUM's, the overall effect would amount to this figure; some ranches would be reduced more than this, some less, and some none at all. But the gross number of AUM's of federal grazing would be reduced by 20 percent.

Reduction in Gross Ranch Income

The work by Caton will provide the information from which the prediction of economic impact can be computed. Caton found the percentage reduction in gross ranch income resulting from a 20 percent reduction in AUM's of federal grazing for each of five ranch size

[13] The project leader for the joint study was D. D. Caton and future reference herein will be to Caton when discussing that study.

categories.[14] Since there exists no justification for believing Caton's data to be inaccurate, it was used in this context to estimate the change in total gross income of the entire Dependent Ranches sector. Table IX illustrates how the total reduction was computed. The total ranch sales (gross income) for the Dependent Ranches sector in 1964 was $3,721,243. The projected gross sales of the sector are $3,321,665 for a direct reduction of $399,578, or 11 percent.

TABLE IX. CALCULATION OF REDUCTION IN GROSS RANCH INCOME OF THE DEPENDENT RANCHES SECTOR RESULTING FROM A 20 PERCENT REDUCTION IN ALLOWABLE FEDERAL RANGE USE.

Size in no. of cows owned	Previous gross income (average)	Percent reduction in gross income	Projected gross income (average)	No. of ranches each size	Total income of each size group (4x5)
(1)	(2)	(3)[1]	(4)	(5)	(6)
< 150	$ 8,777	9	$ 7,987	53	$ 423,311
151-250	17,074	10	15,367	34	522,478
251-400	27,984	11	24,906	25	622,650
401-650	39,900	10	35,910	18	646,380
> 650	96,752	12	85,142	13	1,106,846
Totals				143	$ 3,321,665

[1] From Caton; percent gross income reduction figures are for each of the five size categories as a result of a 20 percent reduction in federal grazing use.

[14] It was necessary for Caton and his colleagues to make some assumptions concerning ranch operation both before, and after, the reduction.

Solution of the Model for a Change in Final Demand

From equation (11) in Chapter III the inverse matrix showing the direct and indirect requirements per dollar of change in final demand is obtained. This is the R, or $(I-A)^{-1}$ matrix and is presented in Table X. Recalling equation (14), the solution of the model is derived by post-multiplying the R matrix by the column vector of projected final demands.

Table XI presents the column vectors of original final demand, and the projected final demand. The only final demand entry which is different is that of the Dependent Ranches sector. The direct loss mentioned earlier is the amount of this difference ($399, 578). All other final demands are identical. The solution of equation (14) of Chapter III yields the new column vector of total outputs for each of the 14 sectors.

It will be noticed that the reduction in gross income of the Dependent Ranches sector is $404, 691. This is greater than the direct loss mentioned earlier ($399, 578) by $5, 113. The reason for this greater loss is because of the interdependence previously mentioned. When the output of the ranching sector decreased, it meant that the members of this sector were buying less from the other businesses in the County. This loss is in part reflected in the lower output of the other sectors. But, as their (the other sector's) output

TABLE X. MATRIX OF DIRECT AND INDIRECT COEFFICIENTS, GRANT COUNTY, OREGON, 1964.

SALES		PURCHASES												
		(1) Dependent Ranches	(2) Other Agriculture	(3) Lumber	(4) Mining	(5) Lodging	(6) Cafes and Taverns	(7) Agricultural Services	(8) Automotive	(9) Communications and Transportation	(10) Professional	(11) Financial	(12) Construction	(13) Products	(14) Services
(1)	Dependent Ranches	1.012810	.074045	.003488	.000404	.001768	.000545	.004542	.000014	.000059	.000021	.000633	.001078	.001059	.001052
(2)	Other Agriculture	.011679	1.017609	.000224	.000007	.000495	.000328	.000056	.000015	.000011	.000024	.000010	.000035	.000084	.005836
(3)	Lumber	0	0	1.090699	0	0	0	0	0	0	0	0	0	0	0
(4)	Mining	0	0	0	1.000000	0	0	0	0	0	0	0	0	0	0
(5)	Lodging	.000530	.001220	.000362	.000232	1.000019	.000056	.000012	.000016	.001128	.000013	.000006	.005656	.000014	.000025
(6)	Cafes and Taverns	0	0	0	0	0	1.000000	0	0	0	0	0	0	0	0
(7)	Agricultural Services	.054319	.040178	.003742	.083829	.036204	.000043	1.000244	.000002	.000044	.000002	.000034	.000263	.000060	.000264
(8)	Automotive	.320594	.250459	.101663	.036046	.244775	.039934	.028336	1.162909	.114507	.001505	.000922	.113454	.005048	.037560
(9)	Communication and Transportation	.006569	.006244	.005595	.003368	.015856	.010811	.008695	.014865	1.022529	.011661	.005300	.015476	.010106	.016197
(10)	Professional	.021201	.041736	.001310	.000110	.007710	.004648	.000179	.001201	.003034	1.000509	.001017	.003602	.002240	.008964
(11)	Financial	.031797	.031714	.005956	.000148	.004644	.003249	.000240	.000159	.008910	.000149	1.000075	.016599	.001530	.006650
(12)	Construction	.009394	.006339	.000327	.004868	.000060	.007780	.000048	.000006	.000206	.000008	.000008	1.011194	.000323	.000069
(13)	Products	.059935	.075341	.064053	.019655	.127675	.485646	.015530	.010943	.050377	.017354	.004812	.117596	1.057536	.047091
(14)	Services	.032180	.050645	.007445	.000204	.080482	.051116	.000554	.002479	.001349	.003920	.000462	.002851	.003368	1.000582

TABLE XI. RESULTS OF A 20 PERCENT REDUCTION IN FEDERAL GRAZING: FINAL DEMAND IN 1964, TOTAL OUTPUT IN 1964, PROJECTED FINAL DEMAND, PROJECTED TOTAL OUTPUT, AND CHANGE IN TOTAL OUTPUT GRANT COUNTY, OREGON.

	Final Demand 1964 $ Y_i	Total Output 1964 $ X_i	Projected Final Demand $ Y_i	Projected Total Output $ X_i	Reduction in Total Output $
Dependent Ranches	3,543,857	3,721,243	3,144,279	3,316,552	404,691
Other Agriculture	999,455	1,066,298	999,455	1,061,631	4,667
Lumber	12,731,894	13,886,670	12,731,894	13,886,670	-
Mining	358,000	358,000	358,000	358,000	-
Lodging	402,610	415,600	402,610	415,388	212
Cafes and Taverns	763,500	763,500	763,500	763,500	-
Agricultural Services	58,092	384,000	58,092	362,295	21,705
Automotive	4,266,168	8,027,277	4,266,168	7,899,175	128,102
Communication and Transportation	759,162	1,088,453	759,162	1,085,828	2,625
Professional	931,848	1,110,118	931,848	1,101,647	8,471
Financial	659,964	922,831	659,964	910,126	12,705
Construction	717,307	780,135	717,307	776,381	3,754
Products	9,513,829	11,812,485	9,513,829	11,788,536	23,949
Services	621,827	1,002,819	621,827	989,961	12,858
Totals		45,399,429		44,715,690	623,739

diminished, they purchased less from others, including the Dependent Ranches sector. While these purchases from the Dependent Ranches sector are not of an outstanding magnitude, their reduction caused the output of the ranching sector to decrease this extra $5,113. This is the indirect loss to the Dependent Ranches sector.

The reduction in federal grazing had different secondary effects upon the various sectors of the economy. The Automotive sector, which provides a large share of the inputs of the Dependent Ranches sector, suffered the greatest loss at over $128,000. The next greatest impact was on the Products sector which lost almost $24,000. The Agricultural Services sector suffered almost a $22,000 loss. The rest of the sectors experienced losses from $12,000 down to zero. Those sectors with no reduction are the ones which sell neither to the Dependent Ranches nor to any other sector within the matrix.

The Household Income Multiplier

The reduction of gross business output of the various sectors is not the only loss which would result from the reduction in federal grazing. When the output of the sectors declines, they will reduce the quantity of labor being demanded by them. The household income effect is depicted with the income multiplier.

The income multiplier is computed using Table X (the R matrix) and the a_{hj} elements (households row, all columns) of Table VIII

(the technical coefficient matrix).[15] M_j, which is the income multiplier of the j^{th} industry, is found by:

$$M_j = \frac{\sum a_{hj} \; r_{ij}}{a_{hj}} \qquad (16)$$

where: a_{hj} represents the purchases of labor services from the Household sector by the j^{th} sector per dollar of gross output of the j^{th} sector,

and r_{ij} represents the elements of the matrix of direct and indirect requirements per dollar change in total output (Table X).

For example, to compute the income multiplier of the Dependent Ranches sector, take (.097761 x 1.012810) + (.178796 x .011679) + (.301076 x 0) and so on down the first column of Table X. To compute the multiplier for the second column (Other Agriculture) the same process is repeated for that column. Following this process for all 14 sectors, there will be 14 sums of products which will represent the numerator of equation (16). Each of these is the direct and indirect change in household income per unit change in the gross output of its respective sector. These coefficients are presented in column 2 of Table XII. To derive the actual income multiplier (M_j) it is necessary to divide this coefficient by the original household

[15] For a more thorough discussion of the income and employments multipliers see Lofting and McGauhey (15), and Moore and Petersen (20).

TABLE XII. DIRECT HOUSEHOLD INCOME CHANGES, DIRECT PLUS INDIRECT HOUSEHOLD INCOME CHANGES, AND HOUSEHOLD INCOME MULTIPLIER FOR THE 14 SECTORS OF THE GRANT COUNTY MODEL, 1964.

	Direct Income Change[1] (1)	Direct Plus Indirect Income Change (2)	Income Multiplier (2 ÷ 1) (3)
Dependent Ranches	.097761	.176134	1.801680
Other Agriculture	.178796	.274293	1.534112
Lumber	.301076	.352179	1.169734
Mining	.198064	.213812	1.079510
Lodging	.174927	.258372	1.477028
Cafes and Taverns	.305384	.383769	1.256677
Agricultural Services	.093750	.102505	1.093387
Automotive	.099760	.124892	1.251925
Communications and Transportation	.420147	.449285	1.069352
Professional	.490788	.499308	1.017360
Financial	.145249	.148780	1.024310
Construction	.166929	.203995	1.222046
Products	.092906	.105858	1.139410
Services	.402265	.423977	1.053974

[1] Elements are from the Household row of Table VIII.

coefficient (a_{hj}). The income multipliers for the 14 sectors in the Grant County model are presented in column 3 of Table XII.

The income multiplier shows how much the total Grant County household income will decline per unit decrease in the net income of the sector listed at the left, assuming all other sectors remain unchanged. Thus for a $1.00 change in the household income of the Dependent Ranches sector, total County household incomes (that paid to the Household sector by all 14 sectors) will fall $1.80.

Impact on Household Incomes from a Grazing Reduction

To project the impact on household income from a 20 percent reduction in federal grazing, several steps are required. First, the decline in household income of the Dependent Ranches sector must be computed. This is done by multiplying the household coefficient of the Dependent Ranches sector (a_{hl}) times the change in output of that sector. Thus,

$$(\$.097761) \times (\$404,691) = \$39,563$$

is the amount that household income in the Dependent Ranches would fall as a result of the reduction.

Then to project the impact on total County household income from this change in the Dependent Ranches income, the income multiplier for the sector is multiplied by this change. This gives:

($39,563) x (1.801680) which yields $71,280.

Thus the loss to total County household income from a 20 percent reduction in federal grazing would be $71,280. More than half of this loss ($39,563 plus) would occur in the Dependent Ranches sector while the remainder would come from the other 13 sectors. The reason the household income loss in the Dependent Ranches sector would be greater than the $39,563 is the same as before; this amount represents the direct loss only. With the households having a lower income, aggregate demand in the County would decline. When this happens, gross sales of the business firms are decreased. They in turn buy fewer labor services from households. The gross sales of the Dependent Ranches sector declines along with the other sectors, and its households receive less income. Admittedly this indirect reduction would be small, but the illustration should demonstrate how the entire economy is tied together.

Change in Trade Relations Following a Reduction

Special mention is warranted regarding the relationship of the various sectors, especially the two agricultural sectors, following a reduction in federal grazing. These relationships are assumed constant in the model but it seems of interest to explore the areas where possible change might occur.

It seems logical that trade between the two agricultural sectors could increase if the Dependent Ranches sector were denied its source

of federal range. There could most likely be an increase in the quantity of hay, pasture, and rangeland owned by the Other Agriculture sector which would be sold or rented to the Dependent Ranches sector. If this happened, the coefficient a_{12}, which represents purchases by the Dependent sector from the Other Agriculture sector, would increase. If this transfer of resources from the Other Agriculture sector to the Dependent Ranches sector did occur, the total output of the Other Agriculture sector would not necessarily decline. As long as its members owned the resources and sold the hay or forage to the Dependent sector, its own output could remain quite constant. This is so because output includes income from all sources, not just the sale of animals.

Another change in a coefficient could occur for intrasector trade in the Dependent Ranches sector. As was mentioned earlier, the 20 percent reduction is in the total quantity of federal grazing use made by the sum of all ranches. A reduction could affect different ranches in various ways. If some ranches lost the majority of their federal permit, the scope of their operation would necessarily be reduced. When this occurred, there might be unused privately owned resources which these ranches would be willing to lease to other Dependent Ranches which also lost a portion of their federal permit. Hence, a_{11} would increase.

If the importation of hay were sizeable the coefficient $a_{17\ 1}$

might be expected to increase. This shows the amount of imports per dollar of output. If the Agricultural Services sector purchased this hay, imported it, and then resold it to the Dependent Ranches sector, two coefficients would change. First $a_{17\ 7}$ would increase reflecting the greater quantity of imports per dollar of sales by the Agricultural Services sector. Then a_{71} would increase reflecting the greater purchases by the Dependent Ranches sector from the Agricultural Services sector.

If the reduction in federal grazing meant that the livestock were closer to the home ranch throughout the year, this might mean that the purchases of vehicles, gasoline, and oil products might diminish somewhat (compare a_{81} with a_{82} in Table VIII; sector 1 spends more per dollar of income than does sector 2, .266553 vs. .188616) per dollar of income. Hence, a_{81} might be expected to decrease somewhat.

There are probably other changes which would occur but speculation concerning these possible changes is hazardous. Much more research and thought is necessary to correctly predict coefficient changes.

VII. SUMMARY AND CONCLUSIONS

Summary

Increasing conflicts over the use of publically-owned lands have created a considerable degree of interest among natural resource economists. Many questions beg answers, not only on the matter of individual ranch impact from changes in land use, but more important, the macroeconomic, or social costs and benefits that result.

This research was concerned with detailing the use of public lands for livestock grazing in eastern Oregon and the study of a smaller area economically dependent upon federal land use in an attempt to show how important one of the uses is to the economic well-being of the area. Grant County, in central eastern Oregon, was selected as the area to be studied. The major agricultural activity in the County is range beef production which is highly dependent upon federally owned lands for seasonal (spring, summer, and fall) forage.

To place grazing of federal lands in proper perspective, a general outline of grazing in eastern Oregon was presented. The first aspect discussed was that of the primary land managing agencies. These are the Bureau of Land Management, the U. S. Forest Service, the Oregon State Land Board, and the U. S. Fish and Wildlife Service. These four agencies control or manage over 55 percent of the

nineteen county area east of the Cascade Mountains. A large share of the land in some of the eastern Oregon counties is in public ownership: 77 percent in Malheur, 73 percent in Harney, and 69 percent in Lake. These three counties have the highest proportion of public lands.

Both the Forest Service and the Bureau of Land Management issue either grazing permits or licenses; the permit is usually of ten year duration while the license is an annual arrangement. Where annual licenses are issued, ranchers have recognized grazing privileges for longer than this period but are required to apply for this privilege each year.

The State Land Board issues annual licenses to ranchers for grazing privileges on the scattered parcels of State-owned land. The U. S. Fish and Wildlife Service also leases forage to ranchers. The two major bird refuges contain excellent cattle forage and ranchers pay between $1.50 and $2.00 per AUM in contrast to the $0.30 to $0.50 for other federal range of poorer quality.

In 1964, 1,442 permits and/or licenses were issued by the Forest Service and the Bureau of Land Management to ranchers in the twelve administrative units studied. There were 284,987 cattle and horses grazed for a total use of 1,194,882 animal unit months of grazing.

Nearly half (47 percent) of the sampled ranches with federal

grazing permits in the eastern part of Oregon were found to be "small" in size by definitions used in this research. That is, they owned less than 200 head of breeding cows. The average number of brood cows owned by ranchers in the small category was 86. This group, though almost half of the ranches with federal permits are in it, used less than 1/6 of the permitted AUM's of grazing during 1964. The average permit was for 56 animal units and the average use per ranch was 231 AUM's.

Thirty-one percent of the permits are in the hands of "medium" sized ranchers. These ranches averaged 273 breeding cows during 1964, and had federal permits for an average of 145 animal units and 600 AUM's of grazing use per ranch. This size group was alloted a little less than thirty percent of the permitted forage in 1964.

The "large" group averages 791 brood cows of which an average of 354 animal units were permitted on federal range for 1,457 AUM's of use per ranch. This size group, though only 18 percent of the permits are held by its members, accounted for nearly 40 percent of the total federal range use in 1964.

The "extra-large" size group comprises only 4 percent of the ranches holding federal permits. The average number of brood cows owned in 1964 was 1,685. An average of 765 animal units were grazed on federal lands for 3,472 AUM's of use per ranch. The extra-large group accounted for 20 percent of the total use of the

federal range in eastern Oregon during 1964.

The type of analysis required to measure the economic importance of public lands for domestic livestock grazing calls for an account of all transactions by the County's businesses. In this manner, the flow of goods and services, and hence money, is traced through the economy. Once this is known, the economic interdependence of business activity in the economy is relatively easy to illustrate. Interindustry, or input-output, analysis was selected as an appropriate tool with which to depict this interdependence.

The theory of input-output analysis was detailed and the solutions of an existing, and a projected system were illustrated. The assumptions of the technique were discussed along with the methods used to subdivide the business activity into sectors. Because national models differ from regional ones, a discussion of the application of the model to a small area was presented.

The recent literature concerning application of input-output models to problems of natural resource economics was reviewed to acquaint the reader with this recent innovation for tracing the beneficiaries of natural resource development projects.

The construction of an input-output model is most tedious; its application to a small area, while of a lesser magnitude than construction of a national model, is not made easier in direct proportion to its reduced coverage. The first of many compromises in regional,

or even national models, is in the aggregation of business activity into sectors. An ideal model would have considerable homogeneity within its sectors. Most often practicality, scarce resources, and limited computer capacity restrict the number of sectors. In this model there are fourteen sectors; two for agriculture, one for lumber, one for mining, and ten for commercial businesses.

Complete enumeration of the agricultural sectors was attempted through mailed questionnaires, while systematic random sampling was utilized to obtain information from the remaining twelve sectors. The data obtained forms the basis for constructing the transactions matrix. The matrix of input-output coefficients portrays the purchase of inputs per dollar of output for each of the sectors. Perusal of the table reporting this relationship reveals some most interesting facts concerning the Grant County economy.

Basic income is a stimulant to an economy because it comes from without. Basic income is created in the Grant County economy on a large scale by the two agricultural sectors and the lumber sector. The Dependent Ranches sector, with a total output of nearly $4 million, exported 83 percent of its output, or $3 million. The Other Agricultural sector exported 78 percent of its total output or $800,000. The Lumber sector exported 90 percent of its nearly $14 million output, or $12 1/2 million. Thus, these three sectors alone, not counting the minerals exported from the county, nor the

tourist dollars left behind, brought $16 1/2 million worth of new money into the economy of the County.

The impact of these three activities upon the local economy can better be visualized when it is realized that the two agricultural sectors purchased almost $0.50 ($0.48 for the Dependent sector, $0.49 for the Other Agriculture) worth of inputs per $1.00 of output from the County's businesses. This figure does not include payments to households for labor and management services. Thus grazing of federal lands by livestock belonging to the Dependent Ranches sector is no small contributor to the economic health of the County. Of the total amount of inputs purchased by the two agricultural sectors from the other sectors in the economy, the Dependent Ranches sector accounted for 77 percent of it, or $1,792,530.

The Lumber sector, again highly dependent upon federal lands for raw materials, spent a much smaller proportion of its gross output within Grant County (only $0.24 out of every $1.00 gross) but in absolute amount it was greater than was spent by the two agricultural sectors combined: $3,304,347 for Lumber vs. $2,317,826 for Agriculture.

While descriptive economics is interesting a more useful function can be served through analysis. The preceding statement of course presupposes that the statistical and conceptual aspects of the research have reached a level of sophistication that the economist can feel

comfortable with the projections therefrom.

Speculation about the ramifications from reductions in the quantity of federal grazing has traditionally been centered around the ranch firm. However, in view of the foregoing account of interdependence in an economy, it seems economists should be interested in more than the microeconomic effects. Following completion of the descriptive portion of the research, it seems reasonable to project the macroeconomic implications to Grant County's businesses from a reduction in one of the multiple uses of the federal lands.

A recent study sponsored by the Forest Service and the Bureau of Land Management was concerned with ranch income changes from a 20 percent reduction in the quantity of federal range use. This data was utilized to arrive at new levels of business activity in the Grant County economy. A 20 percent reduction in federal grazing would reduce gross income for the entire Dependent Ranches sector by 11 percent, bringing the new total sector output to $3,321,665. This reduction of $399,578 is the direct effect from the reduction in federal land use. It is not the total effect, however. With the gross income of the Dependent ranches lowered by this amount, the ranches in this sector will have less to spend. When they buy less from other businesses in the County, these businesses in turn will have lower outputs. With a lower output, their purchases of inputs will be reduced. Thus it is seen that the direct reduction is not the only

change. The remaining 13 sectors in the County will have their total output reduced by $224,161. With this lower gross output, they will in turn purchase fewer inputs from the Dependent Ranches sector. Because of the nature of trade between this sector and the other 13, this reduction is not overwhelmingly large. An additional $5,113 reduction will occur in the Dependent Ranches sector bringing the total of direct and indirect effects to $404,691. In total then, a 20 percent reduction in the quantity of federal grazing in Grant County will cause a $623,739 loss of gross business income in the commercial and agricultural businesses of the County.

The reduction in business income, or gross receipts, is not the only reduction which would result. When businesses (be they commercial or agricultural) are forced to reduce output, while maintaining the same labor force as before, average costs rise. This prompts a reduction in variable costs. For most industries, labor costs are less "fixed" than other variable costs and payments to households for labor and management services might be expected to decrease. The computation of an income multiplier reveals the extent of this decreased household income. Several steps are required in computing the income multiplier. First the impact on payments to households by the Dependent Ranches sector must be computed. Following this, the amount of this change must be multiplied by the income multiplier to arrive at the total change in household income.

The Dependent Ranches sector has an income multiplier of $1.80; this means that for a $1.00 decrease in the household income of the Dependent Ranches sector, total County household incomes will decrease an additional $0.80.

The reduction in payments to the Household sector by the Dependent Ranches sector was $39,563 as a result of a 20 percent reduction in grazing. Multiplying this figure times the income multiplier of 1.801680 yields a total household income loss of $71,280.

Therefore a 20 percent reduction in federal grazing use would cause County businesses to decrease total sales by $623,739, and reduce their payments to households in the County by $71,280.

A necessary assumption in all input-output forecasting is that the explicit trade relationships do not change. In the case of a reduction in use of federal lands by the Dependent Ranches sector it seems unlikely that this assumption is tenable. Nevertheless given time and resource constraints, most input-output studys assume this condition. It was so assumed here.

It is of interest however, to speculate about possible changes in the input-output coefficients. If more trade were initiated between the two agricultural sectors (as substitutions were made to compensate the Dependent sector for its loss of federal grazing) the coefficients relating these two could tend to increase. If the importation of non-County feed became considerable the import coefficients in

row 17 of Table VIII might be expected to increase.

It is not intended that the interpretation from this research be one of doom for federal grazing in Grant County. The purposes of the study were to help depict the aggregate contribution of federal land use to a community and the impact from a change in that use. The only reason that a reduction in grazing was utilized rather than an increase, is that reasonably reliable data were available on the former, and not on the latter.

The Forest Service in Grant County has plans for projects which are deemed to be in the public interest as soon as financing becomes available. These would call for 69, 135 acres of range improvements, 4, 020 acres of wildlife habitat improvement activities, and 548, 638 acres of timber stand improvement activities. Commitments to future uses are impossible to make but it should be emphasized that continued use of the public lands appears to be not unlikely.

Conclusions

While the information obtained from the study and the projections made from it are of interest to Grant County, its applicability to other areas in eastern Oregon, and indeed the West, greatly influence its relevance.

One overriding fact pervades projections made from the model; agricultural production of the same product is basically the same

between and among somewhat similar regions. That is to say that beef production in Grant County requires approximately the same quantity of the various inputs per dollar of output as does beef production in Harney, Baker, Crook or other somewhat similar areas. Ranchers with federal grazing in Grant County can be expected to buy the same proportion of inputs from the Agricultural Services sector, the Automotive sector, the Communications and Transportation sector, the Professional sector, the Financial sector, etc. as do the ranchers with federal grazing in the other eastern Oregon counties, and indeed the similar areas of the western range area.

What will change of course, is the relative importance of federal lands to beef production, and the relative importance of beef production in the total economic milieu. Another variable is that the larger areas would be better able to supply all of the ranchers needs and thus the proportion of inputs which were necessarily imported would be reduced. If the area in question were the nineteen county area of eastern Oregon, if federal range beef production were of similar relative importance in this larger area as in Grant County, then ranchers with federal grazing can be expected to spend at least as much per dollar of output as they do in Grant County. The reason they would spend at least as much, and probably more, is that this larger area would be more self-sufficient than is Grant County. There would be less need to import from outside of the system.

The relative importance of public lands to beef production is not the same in all counties of eastern Oregon as revealed in Appendix Table I. The "dependence-index," which shows the relative degree each county is oriented towards federal range beef production, gives an indication of which counties are similar to Grant. Harney, Grant, and Lake Counties are all very similar according to the index and thus it appears that agricultural activity in the three is equally dependent upon federal lands.

The counties of Baker, Wallowa, Deschutes, Crook, Wheeler, Malheur, Klamath, and Union are ranked behind the other three in the order given. These counties have sizeable tracts of federal range, and the production of beef cattle in relation to the total agriculture is fairly similar. Although ranchers with federal grazing would spend approximately the same quantity per dollar of output in these counties as they would in the first three, the relative importance of federal range operations is less. Hence the relative significance to the total economic output would be somewhat less.

The remaining eight counties of Umatilla, Jefferson, Morrow, Wasco, Gilliam, Jackson, Sherman, and Hood River are ranked in that order of importance. Here one is much less confident in making projections. Other agricultural activities far overshadow the importance of range beef production such that it would be dangerous to imply any similarity between the findings of this research and the

likely consequence in these counties.

While grazing use of federal lands was the primary focus of attention, another public land use is of equal, if not greater importance. Lumber is an important industry in Grant County and most of the log production is from federally-owned lands. A mere 10 percent reduction in the gross output of timber production in Grant County would amount to $1,388,667. Ignoring the loss to business output of the other sectors and just looking at the loss to household income is of considerable interest. This reduction in lumber output would cause household incomes in the Lumber sector alone to fall over $418,000. Given the income multiplier of the Lumber sector of 1.169734, total household income in Grant County would decline by $489,059. This is saying nothing about what would happen to business receipts; this figure concerns family income only.

Implications for Future Research

It is hoped that further research on the aggregate effects of public land use will be forthcoming. This is an important field in this era of reevaluation of public land laws and use patterns. The Public Land Law Review Commission is currently initiating investigations into public land use and such information should be of some interest to them. This research is but a small portion of that which needs to be done for commercial lumber activities, recreational activities

such as hunting and fishing, and any other uses of public lands which contribute to the economic well being of an area. This interest need not be confined to projecting impact from reductions in use. Input-output can work both ways. As pointed out earlier, the use of inter-industry analysis to identify potential beneficiaries from natural resource development projects is a relatively new idea. Development of the range resource benefits not only ranchers but many of the businesses in the rural economy. Greater numbers of hunters and recreationists benefit certain sectors of the economy. All these relationships should be made more definitive.

It is known that multipurpose dams bring tourists to an area and the economic impact is positive. It is also safe to assume that range improvement projects which can mean increased livestock, upland, and big game animals can also have positive effects. Timber stand improvement projects which increase the quantity of marketable timber on a forest can have profound influences on the gross output of many rural businesses as well as household incomes in the area.

The above mentioned phenomena also have some uncertainties about them. What is the effect of different intensities of each use in conjunction with the others? What is the maximum aggregate economic use combination? Is this maximum economic use commensurate with ecological principles? Some of these questions might be answered using a similar type technique as utilized here, coupled with

linear programming. This technique is discussed in Chenery and Clark (5) and involves the marriage of an input-output model to a linear programming model such that a particular objective function is maximized, given certain constraints on land, capital, etc.

Before the economic parameters can be identified however, the biologist must provide some definitive guidelines. If grazing by livestock is completely eliminated does this mean a corresponding increase in wildlife numbers? It is doubtful. Research has shown that in mountainous areas it is not unreasonable to say that deer obtain only about 50 percent of their diet from areas that are regularly used by cattle (26). Dietary preferences even in the same area lend a considerable amount of "economic" complementarity to the combined use by wildlife and cattle. If it is assumed that wildlife numbers could be increased, it is conceivable that the loss from grazing would be made up through increased expenditures by hunters. This would affect different sectors in the economy. The Lodging sector might increase its output as could the Cafes and Taverns sector.

Concomitant with the above is the effect of higher use fees for public lands. If hunting fees are raised, some hunters will be priced out of the market. Presumably there is a fee level which would maximize the nondiscriminating monopolists revenue to the State. Would this fee level be sufficiently high to restrict hunting to an extent that rural businesses suffer from lack of revenue? All these questions

could be approached using input-output; they should be approached if the use of public lands is to be executed with the goal of maximum social welfare in mind.

While the above questions beg answers, one should be reticent to hastily construct input-output models indiscretely. The amount of cost involved warns that considerable discretion is justified in their use. For this reason, more research is needed as to how similar answers might be provided at a lower cost. Some research has been done on this matter; secondary data has been utilized in conjunction with the national model to arrive at coefficients for regions. Refinement of this method is needed. The best way to accomplish this task would be to use data obtained empirically, as in the Grant County model, as a control and then try and duplicate the model from secondary data. If a small number of primary observations were needed to achieve the required accuracy, their cost would certainly be much less than a complete gathering of data as was done here.

These are but a few of the questions which yet remain for the economist to answer. There are many more.

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APPENDICES

APPENDIX 1

FEDERAL GRAZING IN EASTERN OREGON

Table I is a compilation of secondary data and is intended to help illustrate the importance of public grazing lands to the various eastern Oregon counties, the importance of beef production to the total agricultural picture of the nineteen counties, and the rank or relative importance of the respective counties based on these factors.

The Index of Dependence which has been computed is an attempt to rank the nineteen counties in the order of their relative importance as beef producing counties, which are dependent upon public lands for forage. Five factors are considered in computing the index: 1) percentage of total county land area under Forest Service jurisdiction; 2) percentage of total county land area under BLM jurisdiction; 3) percentage of total county land area under ownership of the State of Oregon; 4) percentage of each county's total value of agricultural products sold that were livestock and livestock products; and 5) the percentage of each county's value of livestock and livestock products sold that were cattle and calves. Each of these factors is given equal weight and an average computed for each county.

The rank of the nineteen counties appears below the respective index. Those counties with the highest index are ones where public lands are a good share of the total land area, and where beef production is a considerable share of the total agricultural output.

APPENDIX TABLE I. FEDERAL AND STATE LAND OWNERSHIP, VALUE OF AGRICULTURAL PRODUCTS SOLD, VALUE OF LIVESTRICULTURAL PRODUCTS SOLD, VALUE OF LIVESTOCK AND LIVESTOCK PRODUCTS SOLD, AND VALUE OF CATTLE AND CALVES SOLD, NINETEEN EASTERN OREGON COUNTIES, 1964.[1]

	Baker	Crook	Deschutes	Gilliam	Grant	Harney	Hood Rive	Gilliam	Grant	Harney	Hood River	Jackson	Jefferson	Klamath	Lake	Malheur	Morrow	Sherman	Umatilla	Union	Wallowa	Wasco	Wheeler	Area Totals	State Totals	Area as Percent of State
Forest Service (Acres)	644,953	434,792	966,846	0	1,557,265	516,739	210,346	0	1,557,265	516,739	210,346	427,823	268,902	1,615,549	1,025,918	3,831	136,176	0	401,924	617,827	1,139,037	209,747	165,021	10,342,696	15,001,833	69
Percent	33	23	50	-	54	8	63	-	54	8	63	24	23	42	19	TR	10	-	19	48	56	14	15			
BLM (Acres)[2]	301,416	493,290	430,645	32,038	172,485	3,988,344	276	32,038	172,485	3,988,344	276	43,007	26,162	188,752	2,545,501	4,613,167	47,082	41,182	34,764	6,452	19,089	35,845	85,524	13,109,021	13,299,411	99
Percent	15	26	22	4	6	62	TR	4	6	62	TR	2	2	5	48	73	4	8	2	TR	1	2	8			
State Land Board (Acres)	9,994	25,242	24,381	1,650	4,950	217,069	1,010	1,650	4,950	217,069	1,010	2,262	433	13,867	89,346	262,898	104	1,317	1,612	1,189	2,172	2,237	3,951	665,684	771,304	86
Percent	TR	1	1	TR	TR	3	TR	TR	TR	3	TR	TR	TR	TR	2	4	TR	TR	TR	TR	1	TR	TR			
Other (Acres)	1,017,397	953,876	515,408	741,352	1,165,780	1,762,328	126,928	741,352	1,165,780	1,762,328	126,928	1,329,788	852,663	2,004,552	1,632,035	1,436,904	1,134,398	488,701	1,629,540	675,012	873,622	1,279,851	833,984	20,454,119	32,569,052	63
Percent	52	50	27	96	40	27	37	96	40	27	37	74	75	53	31	23	86	92	79	52	42	84	77			
Total (Acres)	1,973,760	1,907,200	1,937,280	775,040	2,900,480	6,484,480	338,560	775,040	2,900,480	6,484,480	338,560	1,802,880	1,148,160	3,822,720	5,292,800	6,316,800	1,317,760	531,200	2,067,840	1,300,480	2,033,920	1,527,680	1,092,480	44,571,520	61,641,600	72
Value of all Agr. Prod. Sold-1964[3]	8,061,000	7,219,000	4,835,000	5,732,000	4,113,000	5,763,000	6,156,000	5,732,000	4,113,000	5,763,000	6,156,000	14,326,000	16,471,000	24,033,000	5,000,000	34,403,000	7,681,000	6,687,000	31,962,000	9,781,000	4,937,000	8,291,000	1,818,000	207,179,000	428,990,000	48
Value of all Livestock and Livestock Products Sold-1964[4]	5,200,000	3,983,000	3,682,000	1,148,000	3,865,000	5,236,000	621,000	1,148,000	3,865,000	5,236,000	621,000	6,135,000	2,777,000	11,388,000	4,110,000	13,560,000	1,982,000	724,000	11,382,000	4,116,000	3,378,000	2,503,000	1,431,000	88,221,000	178,500,000	49
Percent of Value of Agricultural Products Sold Which was for Livestock and Livestock Products	77	55	76	20	94	91	10	20	94	91	10	43	17	47	82	39	26	11	36	42	68	30	79	42	42	
Value of all Cattle and Calves Sold-1964[5]	4,993,000	3,439,000	1,668,000	990,000	3,552,000	4,860,000	119,000	990,000	3,552,000	4,860,000	119,000	2,460,000	2,290,000	9,300,000	3,704,000	8,400,000	1,510,000	613,000	8,178,000	2,979,000	2,458,000	1,669,000	1,134,000	63,316,000	77,749,000	81
Percent of Value of Livestock and Livestock Products Sold Which was for Cattle and Calves	81	86	45	86	92	93	19	86	92	93	19	40	82	82	90	62	76	85	72	72	73	67	79	72	44	
All Cattle on Farms - 1964[6]	96,000	59,000	33,000	22,000	59,000	109,000	5,000	22,000	59,000	109,000	5,000	55,000	33,000	114,000	83,000	186,000	34,000	12,000	108,000	45,000	47,000	38,000	26,000	1,164,000	1,599,000	73
Dependence Index	41	38	39	22	49	51	18	22	49	51	18	22	25	35	48	36	23	21	26	32	40	23	36			
Rank	4	7	6	16	2	1	19	16	2	1	19	17	13	10	3	9	14	18	12	11	5	15	8			

[1] All acreage figures for federal land as of June 30, 1961 - Source: "Federal Land in Oregon" W. B. Carolan Jr. M. S. Thesis, Department of Natural Resources, O. S. U. Oct. 1962. All acreage figures for State land as of June 30, 1964 - Source: Biennial Report of the Oregon State Land Board - 1962-64 (23).

[2] Public Domain only - doesn't include O & C land.

[3] Source: O. S. U. Extension Service.

[4] Source: O. S. U. Extension Service.

[5] Source: O. S. U. Extension Service.

[6] Source: O. S. U. Extension Service; numbers as of Jan. 1, 1965.

Table II is compiled from data gathered from the twelve administrative units surveyed. The acreage and production figures are from samples of base property surveys for the respective ranch sizes.

APPENDIX TABLE II. ACRES OWNED, ACRES LEASED, AND AUM'S OF VARIOUS FORAGES PRODUCED BY EASTERN OREGON CATTLE RANCHES WITH FEDERAL GRAZING PRIVILEGES, BY RANCH SIZE AND FEDERAL ADMINISTRATIVE UNIT, 1964.

			DESCHUTES NATIONAL FOREST									
			Alfalfa Hay	Meadow Hay	Grain	Wet Meadow	Dry Meadow	Irrigated Pasture	Dry Pasture	Range	Other	Total
SMALL	Owned Land	Acres	71		7		38	8	62	180		366
		AUM's	317		2		25	25	35	20		424
	Leased Land	Acres										
		AUM's										
MEDIUM	Owned Land	Acres	306	44	58			2	60	4411	3	4884
		AUM's	1722	22	211			3	24	438	-	2420
	Leased Land	Acres										
		AUM's										
LARGE	Owned Land	Acres	133	280	187	833		108	67	4876		6484
		AUM's	1344	2084	875	833		237	23	525		5921
	Leased Land	Acres								8000		8000
		AUM's								933		933
EXTRA LARGE	Owned Land	Acres										
		AUM's										
	Leased Land	Acres										
		AUM's										

APPENDIX TABLE II. (Cont.)

			FREMONT NATIONAL FOREST									
			Alfalfa Hay	Meadow Hay	Grain	Wet Meadow	Dry Meadow	Irrigated Pasture	Dry Pasture	Range	Other	Total
SMALL	Owned Land	Acres	140		107			4	200	1010		1461
		AUM's	542		190			16	5	101		854
	Leased Land	Acres	60									60
		AUM's	263									263
MEDIUM	Owned Land	Acres	555		41		531	108	374	2611		4220
		AUM's	2559		374		88	108	94	147		3370
	Leased Land	Acres			100		400			1788		2288
		AUM's			100		13			167		280
LARGE	Owned Land	Acres	883		140		120		983	715	1	2842
		AUM's	3650		712		60		246	69	9	4746
	Leased Land	Acres	550						47			597
		AUM's	1778						12			1790
EXTRA LARGE	Owned Land	Acres	676	723	72			751	733	440	65	3460
		AUM's	3901	7340	1010			2981	183	54		15469
	Leased Land	Acres							3666	3650		7316
		AUM's							917	456		1373

APPENDIX TABLE II. (Cont.)

MALHEUR NATIONAL FOREST

			Alfalfa Hay	Meadow Hay	Grain	Wet Meadow	Dry Meadow	Irrigated Pasture	Dry Pasture	Range	Other	Total
SMALL	Owned Land	Acres	139	22			17			1050		1228
		AUM's	342	36			13			105		496
	Leased Land	Acres	35							253		288
		AUM's	78							25		103
MEDIUM	Owned Land	Acres	140	73	32					1519	91	1855
		AUM's	636	1053	191					443	0	2323
	Leased Land	Acres								324		324
		AUM's								61		61
LARGE	Owned Land	Acres	174	145	33					4570	304	5226
		AUM's	869	618	171					1089	20	2767
	Leased Land	Acres	6	50	2					1336		1394
		AUM's	58	64	10					193		325
EXTRA LARGE	Owned Land	Acres	352	225	120					6330	515	7542
		AUM's	2000	1131	768					1149	308	5356
	Leased Land	Acres	88							1749		1837
		AUM's	262							175		437

APPENDIX TABLE II. (Cont.)

			Alfalfa Hay	Meadow Hay	Grain	Wet Meadow	Dry Meadow	Irrigated Pasture	Dry Pasture	Range	Other	Total
OCHOCO NATIONAL FOREST												
SMALL	Owned Land	Acres	98		66		1		934	570		1669
		AUM's	760		22		1		426	38		1247
	Leased Land	Acres										
		AUM's										
MEDIUM	Owned Land	Acres	197		34				748	6070		7049
		AUM's	1629		262				119	664		2674
	Leased Land	Acres										
		AUM's										
LARGE	Owned Land	Acres	270		150		240		8008			8668
		AUM's	1275		42		1264		1004			3585
	Leased Land	Acres										
		AUM's										
ROGUE RIVER NATIONAL FOREST												
SMALL	Owned Land	Acres	59		4			17	216	30		326
		AUM's	452		31			43	45	3		574
	Leased Land	Acres	14		3				176	2405	2	2600
		AUM's	87		18				57	40	60	262
MEDIUM	Owned Land	Acres	136		1		76	12	598	236		1059
		AUM's	1151		12		76	13	3016	156		4444
	Leased Land	Acres	22						96	2381		2499
		AUM's	168						36	220		424

APPENDIX TABLE II. (Cont.)

			Alfalfa Hay	Meadow Hay	Grain	Wet Meadow	Dry Meadow	Irrigated Pasture	Dry Pasture	Range	Other	Total
WALLOWA-WHITMAN NATIONAL FOREST												
SMALL	Owned Land	Acres	115		151		100		28	1161		1555
		AUM's	636		340		110		7	166		1259
	Leased Land	Acres								344		344
		AUM's								41		41
MEDIUM	Owned Land	Acres	285		3		18		249	1927		2482
		AUM's	1097		24		49		49	258		1477
	Leased Land	Acres								20		2
		AUM's								2		2
LARGE	Owned Land	Acres	398		10					17444		17852
		AUM's	3181		100					2145		5427
	Leased Land	Acres										
		AUM's										
WINEMA NATIONAL FOREST												
SMALL	Owned Land	Acres	295						214	522		1031
		AUM's	893						102	97		1092
	Leased Land	Acres	16							120		136
		AUM's	53							16		69
MEDIUM	Owned Land	Acres	126		175		60	170	75	947		1553
		AUM's	2118		58		97	553	333	164		3323
	Leased Land	Acres								310		310
		AUM's								34		34
LARGE	Owned Land	Acres	803						1390	2903		5096
		AUM's	2889						208	374		3471
	Leased Land	Acres								5228		5228
		AUM's								503		503

APPENDIX TABLE II. (Cont.)

			Alfalfa Hay	Meadow Hay	Grain	Wet Meadow	Dry Meadow	Irrigated Pasture	Dry Pasture	Range	Other	Total
BAKER DISTRICT (BLM)												
SMALL	Owned Land	Acres	32	40	10	2		48	139	88	2	361
		AUM's	297	315	108	2		156	39	16		933
	Leased Land	Acres										
		AUM's										
MEDIUM	Owned Land	Acres	29	108	30	2		45	170	627	3	1014
		AUM's	405	1076	305	2		102	58	142		2090
	Leased Land	Acres										
		AUM's										
LARGE	Owned Land	Acres	172	202	45	38		154		2849	6	3466
		AUM's	1647	1707	365	60		615		423		4817
	Leased Land	Acres										
		AUM's										
PRINEVILLE DISTRICT (BLM)												
SMALL	Owned Land	Acres	35	45		17		19	29	303	5	453
		AUM's	488	324		28		71	23	22	3	959
	Leased Land	Acres										
		AUM's										
MEDIUM	Owned Land	Acres	55	41				84		153	62	395
		AUM's	1037	294				300		11	12	1654
	Leased Land	Acres										
		AUM's										
LARGE	Owned Land	Acres	180	187	21	78	2	137		4005	47	4657
		AUM's	3081	1037	235	81	1	520		404	259	5618
	Leased Land	Acres								16		16
		AUM's								1		1

APPENDIX TABLE II. (Cont.)

			BURNS DISTRICT (BLM)									
			Alfalfa Hay	Meadow Hay	Grain	Wet Meadow	Dry Meadow	Irrigated Pasture	Dry Pasture	Range	Other	Total
SMALL	Owned Land	Acres	10	90	3			2	12	285	160	562
		AUM's	162	382	9			4	13	32		602
	Leased Land	Acres	11	17		2	2	2	11	115	54	214
		AUM's	97	137		2	1	4	14	13		268
MEDIUM	Owned Land	Acres	13	226	8	16		124		905	1049	2341
		AUM's	323	972	80	21		330		61		1787
	Leased Land	Acres					114			450		564
		AUM's					52			45		97
LARGE	Owned Land	Acres		495		85	10	105		2333	56	3084
		AUM's		2614		88	3	269		336	1	3311
	Leased Land	Acres								40		40
		AUM's								305		305
EXTRA LARGE	Owned Land	Acres	159	869	246	710		97	148	7040	95	9364
		AUM's	2606	6482	4190	622		249	136	363	2	14650
	Leased Land	Acres								3134		3134
		AUM's								583		583

APPENDIX TABLE II. (Cont.)

			LAKEVIEW DISTRICT (BIM)									
			Alfalfa Hay	Meadow Hay	Grain	Wet Meadow	Dry Meadow	Irrigated Pasture	Dry Pasture	Range	Other	Total
SMALL	Owned Land	Acres	60	161	8		49		5	76	116	475
		AUM's	723	640	99		200		3	9	4	1678
	Leased Land	Acres										
		AUM's										
MEDIUM	Owned Land	Acres	167	161	7		15		152	388	243	1133
		AUM's	1270	5428	34		20		150	67		6969
	Leased Land	Acres										
		AUM's										
LARGE	Owned Land	Acres	102	218	62	244		33		888	69	1616
		AUM's	1320	1755	306	943		102		138		4564
	Leased Land	Acres								152		152
		AUM's										
EXTRA LARGE	Owned Land	Acres	140	840	104	4		351	16	524	85	2064
		AUM's	3739	8623	1196	8		1381	7	57		15011
	Leased Land	Acres										
		AUM's										

APPENDIX TABLE II. (Cont.)

			VALE DISTRICT (BLM)									
			Alfalfa Hay	Meadow Hay	Grain	Wet Meadow	Dry Meadow	Irrigated Pasture	Dry Pasture	Range	Other	Total
SMALL	Owned Land	Acres	44	11	124	14		11	18	131	12	365
		AUM's	485	113	148	14		34	8	17		819
	Leased Land	Acres	3						3			6
		AUM's	18						1			19
MEDIUM	Owned Land	Acres	179	54	5	8		17	12	955	12	1242
		AUM's	1822	172	5	8		144	8	126		2285
	Leased Land	Acres								9		9
		AUM's								1		1
LARGE	Owned Land	Acres	125	32	26	2	136	12	456	864	52	1705
		AUM's	2434	46	204	2	68	37	572	76		3439
	Leased Land	Acres										
		AUM's										
EXTRA LARGE	Owned Land	Acres	204	565	17	39	72	320	307	4780	45	6349
		AUM's	2145	3675	134	43	36	1076	749	523		8381
	Leased Land	Acres										
		AUM's										

APPENDIX II

QUESTIONNAIRES FOR THE INPUT-OUTPUT MODEL

Agricultural Questionnaire - Mailed

GRANT COUNTY ECONOMICS STUDY

Department of Agricultural Economics
Oregon State University, Corvallis

1. What were your total gross receipts, or income, from all ranch sales and/or services performed during the year 1964? (Include here any timber sold, the value of work performed for someone else, or cash value of machinery sold, as well as the value of all products sold.) $_____

2. Did you receive any of the amount in question (1) above from either the state government of Oregon or the Federal government? (Include here conservation payments, etc.) If so, how much? $_____

3. Enter the amount of your non-government ranch income that came from OUTSIDE of Grant County? (An example would be cattle sold in Portland. Also, if you sold cattle at your ranch, but to someone from OUTSIDE of Grant County, this is a sale which should be entered here.) $_____

4. If you received any income from sources within Grant County would you please indicate by estimating the dollar amount of this figure that came from each of the following business categories in Grant County? (If you had no sales to some of the categories please enter a zero. Remember (for example) a sale to the owner of a cafe for his personal use, not business, will be entered in the "household" (o) category.)

   a) Income from sales to "Privileged" ranches - these are ranches with privileges on Forest Service or Bureau of Land Management land. $_____

   b) Income from sales to "Nonprivileged" agricultural producers - these are all others who obtain their major income from farming or ranching but that do not have Federal grazing privileges. $_____

c) Income from sales to the lumber industry - this includes mills, loggers, and truckers of logs or lumber. $_____

d) Income from sales to the mining industry. $_____

e) Income from sales to hotels, motels, trailer parks, apartments, and resorts. $_____

f) Income from sales to cafes and taverns. $_____

g) Income from sales to agricultural services - this includes feed, seed, and machinery stores. $_____

h) Income from sales to service stations, new and used car and truck sales, auto repair shops, tire dealers, auto parts and supplies, and machine shops. $_____

i) Income from sales to the communications and transportation industries - this category includes radio station, newspapers, trucking firms, Western Union, T. V. cable, bus railroad, telephone and aircraft. $_____

j) Income from sales to the professional services - this category includes physicians, dentists, attorneys, eye doctors, veterinarians, accountants, and the hospital. $_____

k) Income from sales to the financial institutions - this category includes the bank and loan company. $_____

l) Income from sales to the construction industry - this includes plumbing and electrical contractors, heavy construction firms (sand and gravel) and the building material stores. $_____

m) Income from sales to product selling firms - this category includes grocery, clothing, shoes, furniture, appliances, department and variety stores, drug stores, florists, jewelers, office supplies, electric and gas companies, dairy, photographers, saddle shops, Sears, Montgomery Ward, liquor store, saw shop, etc. $_____

n) Income from sales to service selling firms - this includes barber and beauty shops, insurance, real estate, laundry, churches, Elks Club, movies, bowling, golf, cobbler, tailor, garbage collection, gunsmith, undertaker, credit bureau, Chamber of Commerce, and John Day Valley Pack, etc. $_____

o) Income from sales to households - this is a sale to anyone for his own pleasure or need, in or out of his home. It is not a business expense by him. $_____

p) Income from sales to the local government - this category includes any city government in the county as well as the government of Grant County. $_____

5. Did you purchase any machinery, buildings or other capital investment items during 1964? If so, what was your total expenditure for these items? $_____

6. Of the amount entered in Question 5 above, how much of this was spent outside of Grant County? $_____

7. Of the remaining amount spent in Grant County would you please itemize the 1964 BUSINESS INVESTMENT purchases below? (If you need more space please use back of sheet)

Investment Item	Real Price Paid (purchase price minus trade-in)	Name of Business Where Purchased

8. How much total depreciation was taken on your ranching business during 1964? $_____

9. What was the total amount paid to hired labor during 1964? $_____

10. What was the amount of your net profit for 1964? (Include here the value of any family labor not entered in question 9 above.) $_____

11. If your business is a corporation, what was the value of compensation of officers during 1964? $_____

12. Did you have any other income from interest, rent, royalties, dividends, or other sources? If so, would you please itemize them below? (If you need more space please use back).

Amount	Source of Income (for example, house rental, land rental)	Location of Source (Grant County, Harney County, Idaho, etc.)

13. What was the amount of your tax payments for 1964?

a) Local taxes (real estate, personal property, business licenses)? $_____

b) State tax (unemployment and income, truck licenses)? $_____

c) Federal tax (Social Security and income)? $_____

14. What was the value of your inventory:

At the beginning of 1964? $_____

At the ending of 1964? $_____

COMMERCIAL BUSINESS QUESTIONNAIRE - PERSONAL INTERVIEW

OREGON STATE UNIVERSITY

Firm _____

Sector _____

Interviewer _____

1. What were your gross receipts from the sale of merchandise and service during 1964? $_____

2. What was the value of your sales which were destined to go outside of Grant County?

   $_____

3. What was the value of receipts from any agency of local, state or Federal government?

   (a) Local $_____

   (b) State $_____

   (c) Federal $_____

   (d) Total $_____

4. What was the value of your sales to each of the following types of businesses in Grant County?

   (a) Privileged cattle ranches $_____

   (b) Other agricultural producers $_____

   (c) Lumber industry $_____

   (d) Mining Industry $_____

   (e) Lodging $_____

   (f) Cafes and taverns $_____

   (g) Agricultural services $_____

   (h) Automobiles and repair $_____

(i) Communications and transportation $_____

(j) Professional services $_____

(k) Financial institutions $_____

(l) Construction $_____

(m) Product oriented firms $_____

(n) Service oriented firms $_____

(o) Private individuals $_____

5. What was the value of new equipment, machinery, buildings or other capital items purchased during 1964?
$_____

6. How much of this was for purchases made outside of Grant County? $_____

7. What was the value of these items purchased from any agency of local, state, or Federal government?
$_____

8. What was the value of the purchases of capital items made in Grant County from each of the following types of businesses?

(a) Privileged cattle ranches $_____

(b) Other agricultural producers $_____

(c) Lumber industry $_____

(d) Mining industry $_____

(e) Lodging $_____

(f) Cafes and taverns $_____

(g) Agricultural services $_____

(h) Automobiles and repairs $_____

(i) Communications and transportation $_____

(j) Professional services $_____

(k) Financial institutions $_____

(l) Construction $_____

(m) Product oriented firms $_____

(n) Service oriented firms $_____

(o) Private individuals $_____

9. What was the amount of depreciation taken during 1964?
$_____

10. What was the total amount paid to your employees, including yourself, during 1964? $_____

11. Out of this total how much was paid to nonresidents of Grant County? $_____

12. Corporations only - what was the value of compensation of officers during 1964? $_____

13. Corporations only - out of this amount how much was paid to nonresidents of Grant County? $_____

14. What were the total receipts paid to you for interest, rent, royalties, dividends? $_____

15. What were the total receipts from these sources paid to you by any agency of local, state, or Federal government?
$_____

16. What was the value of these receipts from individuals and businesses of the following types in Grant County?

(a) Privileged cattle ranches $_____

(b) Other agricultural producers $_____

(c) Lumber industry $_____

(d) Mining industry $_____

(e) Lodging $_____

(f) Cafes and taverns $_____

(g) Agricultural services $_____

(h) Automobiles and repairs $_____

(i) Communications and transportation $_____

(j) Professional services $_____

(k) Financial institutions $_____

(l) Construction $_____

(m) Product oriented firms $_____

(n) Service oriented firms $_____

(o) Private individuals $_____

17. What was the value of your tax payments during 1964?

(a) Local $_____

(b) State $_____

(c) Federal $_____

18. What was the value of your inventory change, if any, during 1964?
$_____